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TRACALS EVALUATION REPORT. COMMUNICATIONS INITIAL EVALUATION RE--ETC(U)
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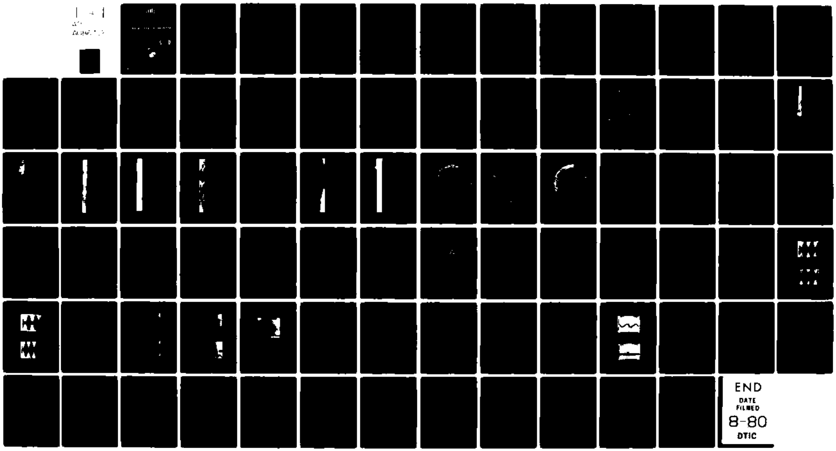

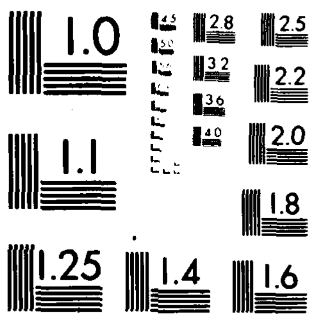
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TRACALS EVALUATION REPORT.

COMMUNICATIONS INITIAL EVALUATION REPORT,

Keesler AFB, Mississippi,

~~80/66C-204~~

10-15 March 1980.

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DEPARTMENT OF THE AIR FORCE
1866 Facility Checking Squadron
Scott AFB, Illinois 62225

15 May 1980

COMMUNICATIONS INITIAL EVALUATION REPORT

Keesler AFB, Mississippi

80/66C-204

10-15 March 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A Communications Initial Evaluation was performed at Keesler AFB, Mississippi from 10-15 March 1980. The purpose of the evaluation was to define the capabilities and limitations of the reconfigured ATC communications system. Included in this report are the results and analysis of ground equipment and system measurements, and correlation of predicted and measured receive signal levels as they affect horizontal and vertical coverage. This report can be used as a guide for anticipated performance of the ATC communications system until there is a deletion, addition, relocation of equipment, or a change in the horizon profile.

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ATTACHMENTS

GLOSSARY

AGC	Automatic Gain Control
AGL	Above Ground Level
AP	Anomalous Propagation
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATIS	Automatic Terminal Information Service
BRITE	Bright Radar Indicator Tower Equipment
dB	Decibel
dBm	Decibel Above/Below 1 Milliwatt
EMI	Electromagnetic Interference
FCS	Facility Checking Squadron
GATR	Ground-to-Air Transmitter and Receiver
GCA	Ground Control Approach
IF	Intermediate Frequency
IFR	Instrument Flight Rules
KHz	Kilohertz
KW	Kilowatt
LOS	Line of Sight
LPA	Linear Power Amplifier
MEA	Minimum Enroute Altitude
MHz	Megahertz
MOA	Military Operating Area
MSL	Mean Sea Level
MVA	Minimum Vectoring Altitude
NCA	Northern Communications Area
NM	Nautical Miles
PAR	Precision Approach Radar
PCA	Pacific Communications Area
PTD	Pilot-to-Dispatcher
PMSV	Pilot-to-Metro Service
RAPCON	Radar Approach Control
RF	Radio Frequency
RLOS	Radio Line of Sight
RSL	Received Signal Level
SACCA	Strategic Communications Area
SCA	Southern Communications Area
SM	Statute Miles
SSILS	Solid State Instrument Landing System
TACAN	Tactical Air Navigation
TCA	Terminal Control Area
TDR	Time Domain Reflectometer
TRACALS	Traffic Control and Landing Systems
UHF	Ultra High Frequency
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omnirange
VORTAC	VHF Omnirange Tactical
VSWR	Voltage Standing-Wave Ratio

1. SUMMARY

1-1. Evaluation Profile. This evaluation was conducted to define the capabilities and limitations of the reconfigured Air Traffic Control (ATC) communications system at Keesler AFB, Mississippi. This reconfiguration included the replacement of the control tower and the consolidation of the remoted transmit and receive facilities. This report replaces the station evaluation conducted in May 1978. This initial evaluation was accomplished in two phases: a ground phase and a flight phase. The ground phase consisted of extensive testing of a representative sample of the ATC communications equipment. Seven transmitters, seven receivers, two multi-channel transceivers, and all ATC antenna systems were evaluated. The control tower four channel communications control system and the associated cabling were also examined. The ground phase also included examination of equipment siting and checks of commercial/backup power systems. The transmit and receive equipment on frequency 320.1 MHz was optimized to eliminate any possible effects from equipment related signal degradation during the flight phase of the evaluation. Flight phase data was used to characterize the capabilities and limitations of the ATC communications.

1-2. ATC Communications System:

a. Ground Phase. Four areas required special attention: transmitter modulation, transmitter power output, receiver audio compression, and VHF electromagnetic interference (EMI). Transmitter modulation levels were below TO specifications on 65% of the radios checked. Low modulation levels can result in reduced aircraft receiver audio levels. All but one transmitter had power output levels below TO specification. The cause of this low output power was the use of an incorrect sensing element in the RF thru-line power meter. The audio compression option was not being used on all AN/GRR-23 and AN/GRR-24 receivers. A lack of receiver audio compression will allow undesirable variations in receiver audio levels when aircraft transmitter modulation levels vary. Extensive analysis was conducted to determine the source of the mutual electromagnetic interference being experienced on the three VHF frequencies at the GATR site. The source of the interference was near field coupling between transmit and receive antennas.

b. Flight Phase. Antenna interaction caused by the close spacing of the UHF antennas produced strong nulls in the measured horizontal radiation pattern. However, signal levels in the nulls were still adequate to meet communications coverage requirements. Backup communications coverage exceeded that of the primary communications equipment. Flight phase data showed communications coverage extending well beyond 30 NM on all radials flown. Communications coverage was adequate to meet mission coverage requirements. Horizon screening was negligible. Airborne radio voice checks were satisfactory.

1-3. Power Systems. Voltage and current measurements were made on the primary and backup power systems for the ATC facilities. The automatic changeover systems were tested by simulating a primary power failure. Commercial and backup power were adequate and reliable for the GATR site and the control tower.

2. RECOMMENDATIONS

2-1. ATC Communications System:

a. Recommend a local test procedure be developed and approved for measuring transmitter modulation levels using the collocated associated single channel receivers (see Appendix III, para 4a(3)).

b. Recommend lower wattage (10 and 25 watt) elements be obtained for the thru-line power meter to allow more accurate adjustment of transmitter power output (see Appendix III, para 4a(2)).

c. Recommend the audio compression option be utilized IAW TO 31R2-2GRR-112 (see Appendix III, para 4a(1)).

d. Recommend engineering support be requested to eliminate EMI on VHF frequencies and to minimize RF coupling between antennas. Interim measures to reduce interference are provided (see Appendix III, para 4a(4) and 4b(1)(b)).

2-2. Power Systems. No recommendations.

3. PERFORMANCE PREDICTIONS. The ATC communications system at Keesler AFB can be expected to provide adequate service to meet mission requirements. The control tower, PMSV, PTD, and ATIS will meet the communications requirements outlined in AFM 55-8, United States Standard for Flight Inspection.

APPENDIX I

GENERAL INFORMATION

1. Facility Data:

   a. General:

      Location: Keesler AFB, Mississippi
      Communications Area: Southern Communications Area
      Unit: 2052 Communications Squadron
      Evaluation Period: 10-15 March 1980

   b. Site Data:

      (1) Control Tower:

Coordinates:	30° 24' 36" N
	88° 55' 24" W
Site Elevation:	21 feet MSL
Antenna Height:	94 feet MSL

      (2) GATR Site:

Coordinates:	30° 24' 37" N
	88° 55' 56" W
Site Elevation:	21 feet MSL
Antenna Height:	87 feet MSL

2. Airfield Data:

Airfield Coordinates:	30° 24' 49" N
	88° 55' 26" W
Airfield Elevation:	19 feet MSL
Magnetic Variation:	3.5° East

3. Mission Area. The Keesler ATC communications system provides communications throughout the Keesler AFB Control Zone, which is that area within five SM of the geographic center of the airport with extensions northeast and southwest (see Attachment 2). The airport traffic area is that airspace within a radius of five SM from the geographical center of the airport, extending from the surface up to, but not including, 3000 feet AGL.

4. Mission Responsibility. The Keesler AFB Control Tower provides VFR services to all aircraft arriving, departing, or transiting the Keesler Airport Traffic Area. Gulfport Approach Control provides IFR service to Keesler AFB using an ILS approach to Runway 21.

5. Primary Using Agencies/Aircraft Supported. The primary using agencies are the 53rd Weather Reconnaissance Squadron, the 920th Air Force Reserve Weather Reconnaissance Group, and the 7th Airborne Command and Control Squadron (TAC). Aircraft supported include C-130, C-9, Aero Club aircraft and transient Army, Navy and Coast Guard aircraft.

6. <u>ATC Facilities</u>. The ATC facilities at Keesler AFB consist of a VFR control tower equipped with an AN/GSA-135 console and a remoted GATR site. ATIS, PTD and PMSV services are provided. NAVAIDS include an AN/GRN-19A TACAN and AN/GRN-27 SSILS providing service to Runways 03/21.

7. <u>Logistics Support</u>. Logistical support, including test equipment calibration, is provided by host base organizations.

APPENDIX III

ATC COMMUNICATIONS SYSTEM

1. System Description:

a. General. ATC communications at Keesler AFB are provided by remoted VHF/UHF radio equipment. Landlines interconnect the GATR facility with the control tower. A four channel communications control system provides keying, amplification and control of the audio signals at the control facility. The primary communications antennas are mounted on a metal tower (see Attachment 3). The control tower contains backup communications equipment (see Attachment 4).

b. Facility Equipment:

(1) VHF/UHF Radios and Associated Equipment:

NOMENCLATURE	QUANTITY	USE
AN/GRT-21	5	VHF Transmitter
AN/GRT-22	10	UHF Transmitter
AN/GRR-23	4	VHF Receiver
AN/GRR-24	9	UHF Receiver
AN/GRR-25	1	VHF Receiver
AN/GRC-171	1	UHF Transceiver
AN/GRC-175	1	VHF Transceiver
CU-547/GR	2	UHF Antenna Multicoupler
AS-1097/GR	5	UHF Antenna
AT-197/GR	2	UHF Antenna
AS-1181/UR	5	VHF Antenna
DB-4015-1	2	VHF Filter

(2) Frequency Allocation:

FREQUENCY (MHz)	USE
121.5	Emergency
121.8	Ground Control
126.2	VHF Primary
243.0	Emergency
271.8	ATIS
275.8	Ground Control
320.1	UHF Primary
344.6	PMSV
372.2	PTD

c. Environmental Factors:

(1) Siting Characteristics:

(a) General. Keesler AFB is located on the south central Gulf Coast at Biloxi, Mississippi (see Attachment 1). The Gulf of Mexico is one half mile south of the base with the Back Bay of Biloxi bordering the north side of the base.

(b) GATR Site. The GATR site is located on the west side of the base, approximately 1400 feet northwest of the approach end of Runway 03. The terrain surrounding the site is flat with numerous pine and evergreen trees (see Attachment 5 for skyline screening data).

(c) Control Tower. The control tower is located approximately 800 feet southeast of the runway center. The terrain surrounding the control tower is flat and generally covered by concrete and asphalt. Skyline screening data is provided in Attachment 6.

(2) Weather:

(a) General. A statistical description of the surface climatology at Keesler AFB, giving annual temperature, precipitation, winds, and flying conditions is shown in Attachment 26. A description of refractive index categories and their gradients in "N" units per thousand feet is found in Attachment 11.

(b) Evaluation Weather Conditions. Statistical analysis of AP forecasts indicated normal "N" profiles and propagation conditions during the evaluation flight phase had no adverse effects on the flight phase data.

(3) Electromagnetic Environment. The Keesler ATC communications system has a history of EMI. The external EMI previously noted during the station TRACALS evaluation of May 1978 was not observed during this evaluation nor have control tower personnel noted this external interference since the transmitter and receiver sites were collocated. Mutual interference has been reported on the three ATC VHF frequencies since the sites were collocated.

2. <u>Equipment Status:</u>

a. General. Equipment tests were accomplished using procedures described in the equipment technical orders. Where no procedures are given, AFCCP 100-61, Vol XIII was used as guidance. Five transmitters, five receivers and all ATC antenna systems were evaluated at the GATR site. A representative sample of the four channel communications control system at the control tower was also evaluated and aligned. Discrepancies were identified to local maintenance personnel. The specifications and equipment test results are contained in Attachments 12 through 20. The evaluation team also made an extensive study of the VHF interference problem. Data from that study is contained in Attachment 15.

(1) Primary Transmitters. All transmitters checked had low power output and three had low modulation. One transmitter had a distorted modulation envelope (see Attachment 14). This transmitter also had a bad A1

Audio Compressor card which was causing a loss of approximately 10 dB in the audio input signal.

(2) Primary Receivers. Two receivers had sensitivity greater than 3 microvolts and signal-to-noise ratios less than 10 dB. The audio line levels of four receivers were other than 0 dBm at the patch panel. All were adjusted for 0 dBm into the landlines. Three receivers, all equipped with the older configuration AGC/Squelch module, were not adjusted for audio compression. These were adjusted for desired audio compression during the evaluation.

(3) Primary RF Transmission Systems. One DB-4015 VHF RF filter had an insertion loss in excess of 14 dB at the center frequency and could not be tuned or adjusted properly. At the suggestion of the evaluation team, the local maintenance personnel temporarily rerouted the transmission line around the filter. Two spare UHF antennas (AS-1097) had high VSWR. Transmission line labeling was inconsistent and extremely confusing. Labels at the equipment, building exit point, and the antennas did not match on a majority of the lines. This lack of uniform labeling was also evident in the Plant-In-Place Records. Local maintenance should establish correct labeling and ensure the Plant-In-Place Records are updated to conform to actual labeling.

(4) VHF Interference Study. All three VHF frequencies (121.5 MHz, 121.8 MHz, and 126.2 MHz) were experiencing mutual interference. The equipment assigned to those frequencies was examined for spurious emissions. No spurious emissions were found at or near the three VHF frequencies or their possible harmonics. The 121.8 MHz receiver was examined for RF selectivity and IF bandwidth and was within TO specifications. The effects of the interference were eliminated by increasing the squelch threshold levels of the three receivers well above 3 uv and by interchanging antenna systems (see page A15-1, Table 2). All tests performed to discover the cause of the interference showed no problems in primary transmit or receive equipment. The source of the interference is antenna proximity and interaction. Off-channel signal levels up to 0.1 watt were measured on the receiver antenna inputs of the three receivers. Off-channel signal strength levels at the GATR site are listed on page A15-1.

(5) Four Channel Communication Control System. The patch panel was mislabeled for 243.0 MHz and 275.8 MHz. Three line amplifiers had high distortion. Four speaker amplifiers and one phone amplifier had high distortion during the gain check, but only one of these showed high distortion when aligned and checked in the system. The input levels of all the speakers and phone amplifiers could not be measured because of a defective jack on the amplifier extender board. One power supply PP-4558, #2567, had a 0.15 volt peak-to-peak RF signal on the output. (see page A17-4).

(6) Landlines. Landlines between the control tower and the GATR site were checked for audio signal loss and noise levels. The landline between the control tower and the 126.2 MHz primary transmitter had a loss of 6.9 dB and a noise level of -30 dBm. All receive landlines had high noise levels.

(7) Backup Equipment Status. Two transceivers, two transmitters and two receivers were evaluated in the control tower. Four antenna systems were also examined.

(a) Multichannel Transceivers. The VHF transceiver had low

modulation and high sensitivity. The squelch threshold level was high. The UHF transceiver was found to have an intermittent open RF link, between the "XCVR" output and the "ANT" input jacks. This could cause the transceiver to have very low power output and high VSWR.

(b) Single Channel Backup Equipment. Both transmitters had low modulation with highly distorted modulation envelopes. (see Attachment 14). The 126.2 MHz transmitter modulation was corrected during the evaluation but the 320.1 MHz transmitter was turned over to local maintenance for troubleshooting. The 126.2 MHz transmitter had out-of-tolerance frequency accuracy. The VHF receiver squelch threshold level was set at 27 mV and could not be adjusted below 5 uV. The UHF receiver contained an older configuration AGC/Squelch module which was not set for audio compression. This receiver was adjusted to TO specifications during the evaluation.

(c) RF Transmission Systems. The antenna associated with the 126.2 MHz backup equipment had high VSWR.

b. Supporting Test Equipment Status. Adequate test equipment was available to the radio maintenance section. However, low wattage elements for the thru-line wattmeter would increase the accuracy of the transmit power output checks. The 100 watt element currently in use is not accurate enough for checking a 10 watt transmitter.

3. Evaluation Overview. The overall objective of this evaluation was to define the capabilities and limitations of the ATC communications equipment in its installed environment at Keesler AFB. The best way to determine these capabilities is to measure RSL using a calibrated radio receiver. These results are then compared to the theoretical predictions and previous data from similar facilities. Before measuring RSL, the equipment must be eliminated as a source of significant variations in performance. Therefore, the evaluation was conducted in two phases: a ground phase and a flight phase. Specific objectives and methods are explained in the following paragraphs.

a. Ground Phase:

(1) To ensure that equipment performance had no adverse effect on the evaluation results, extensive checks were performed on major end items to verify that the equipment met TO specifications. Where TO specifications were not available, the data base built from prior evaluations was used.

(2) To ensure that total system performance had no adverse effect on communications quality, loop tests were performed from an operational position in the control tower to the remote GATR facility. A one kHz tone was injected into a microphone amplifier for simulation of a normal voice input. Then signal level and signal-to-noise ratio (noise floor) measurements were made on the transmit portion of the system. The one kHz tone was then removed and noise measurements were taken. The same audio measurements were taken on the receive side of the system by injecting a 30% modulated RF carrier into the input of the receiver. The resulting data was used to determine the signal levels presented on the Loop Test Line Level Diagrams (see Attachment 19).

b. Flight Phase. The flight phase was accomplished using a C-140A flight inspection aircraft flying radials and orbits off the Keesler TACAN to

determine the outer limits of communications coverage and the areas of degraded coverage within those limits. Predictional tools used in the analysis of flight phase data are contained in Attachments 9, 10 and 11. The details of the flight profile are given in Attachment 21. Prior to the airborne tests, the strip chart recorder in the aircraft was calibrated in dBm by injecting known signal levels into the receiver and annotating these values on the recording paper. The annotated recordings serve as a scale to convert the received signal strength to dBm. Since the facility has several frequencies, the highest frequency available was used to collect airborne data. This constituted the worst case condition due to the increased attenuation and line of sight characteristics present at higher frequencies. Using this data, the specific evaluation objectives were to determine:

(1) If coverage is provided for the control tower to 15 NM at the lowest traffic pattern altitude.

(2) If coverage is provided for ground control at all locations on the ramps, taxiways, and parking areas.

(3) If coverage is provided for the PMSV at the MEA to 40 NM.

(4) If coverage is provided for the ATIS to 30 NM.

4. Analysis of Evaluation:

a. Ground Phase. A representative sample of the ATC communications equipment was tested extensively with the data results shown in Attachments 13 through 20. Equipment out-of-tolerance conditions are discussed in paragraph 2 of this appendix with emphasis on major discrepancies. Minor maintenance was performed on an as required basis during the equipment checks. The following are items which could impact system operations. All other end items appeared to be in satisfactory condition and were able to provide adequate service.

(1) Receiver Audio Compression. The AN/GRR-23 and AN/GRR-24 receivers have audio compression available as an option when the early configuration AGC/Squelch module is installed. The audio compression provides a stable audio output for varying received modulation levels. As the compression is an option, many receivers are not adjusted to incorporate it. The receiver technical order 31R2-2GRR-112 provides a compression alignment procedure in paragraph 3-11. This procedure is an option for receivers with the early configuration AGC/Squelch module (Part #8004239G1). If the compression option is not used, the audio will vary as much as 7 dB as the received signal percent of modulation varies from 30 to 90%. This variance is limited to less than 2 dB when the compression option is used. The ATC communications system technical order 31Z3-220-6WC-1 provides the specifications for receiver audio compression. An improvement in air-to-ground voice quality will result from the use of the audio compression option, as there will be little fluctuation in audio output as the percent of modulation varies. In addition, the receiver output should be set for an output of 20 dBm into the receiver line attenuator. The line attenuator then should be set to provide 0 dBm into the landlines to the control facility. This standard level gives a constant signal level to the amplification equipment in the control facility and provides uniformity in system performance.

(2) Transmitter Power. The power output on all but one of the AN/GRT-21 and AN/GRT-22 transmitters tested was below the 10 watt specification. The power meter used to set transmitter output power, the Bird Model 43 thru-line watt meter, had only a 100 watt element available. The accuracy of this instrument is specified at ±5 percent of full scale. The measurement error possible when using a 100 watt element could allow an actual output level to range from a low of 5 watts to a high of 15 watts when the indicated value is 10 watts. The actual power output of the transmitters averaged 2 watts below specified values which equates to a 10 percent reduction in range capability. Sensor elements of 10, 25, 50, 100, and 250 watts are available for the Bird Model 43 wattmeter. When the appropriate elements are used, only insignificant variations in coverage will occur.

(3) Transmitter Modulation. Transmitter percent of modulation was below TO specifications on five of seven transmitters and on one of two transceivers checked. Low modulation levels will cause a reduction in aircraft receiver audio levels and will also produce a slight reduction in communications coverage. TRACALS technicians reviewed modulation adjustment procedures with local maintenance personnel who adjusted modulation levels to TO specifications. Because the transmitters and receivers are collocated, another method can be used to observe the modulation envelope and the percent of modulation while adjusting the transmitter. When the transmitter is keyed into a dummy load IAW 31R2-2GRT-106WC-1, there is sufficient RF feedover to the receiver input to allow the signal to be monitored at the IF output jack, J-10. The visual display of the modulation envelope also provides an excellent indication of transmitter distortion as was the case during this evaluation (see pages A14-1 and A14-2). Several transmitters had distortion levels which could not be readily adjusted to TO specifications and required additional troubleshooting.

(4) VHF EMI:

(a) The source of interference at the GATR site on 121.5 MHz, 121.8 MHz, and 126.2 MHz was the high signal levels present at the receiver inputs when a collocated VHF transmitter was keyed. Near field coupling of the transmit and receive VHF antennas provided the path for the unwanted signals. The interference between 121.5 MHz and 121.8 MHz was the result of inadequate frequency separation. This 0.3 MHz frequency separation is far less than the 3.0 MHz minimum frequency separation specified for a collocated site in TO 31R2-GRR-112, paragraph 3-17. Additionally, TO 31R-10-3, Figure B-29 indicates that off-channel interfering signals stronger than -18 dBm (16 microwatts) at 0.3 MHz frequency offset can degrade receiver signal-to-noise performance. It is also clear from Figure B-29 that any off-channel signal level above 4 dBm (2.5 milliwatts) may cause interference. Transmitted signals measured at the receiver inputs showed near field antenna coupling causing interfering signals well above these allowed levels (see page A15-1, Table 1). Photo 8 on page A15-3 presents an actual interfering signal as it appeared in the receive IF amplifiers. The interfering levels were so high they exceeded the rejection capability of the IF bandpass and appeared as noise (garbled audio) on the receiver output. Spurious emissions from the transmitters did not contribute to the EMI problem. Examination of spurious emissions on the 121.8 MHz and 121.5 MHz transmitters showed the equipment operating well within TO specifications with no detectable emissions on the three assigned VHF frequencies (see photos 5, 6, and 7 on pages A15-2 and A15-3). The DB-4015 VHF bandpass filter for 121.8 MHz was functioning properly and provided significant rejection of the 126.2 MHz signal but had almost no effect on the interfering signal from the 121.5 MHz

transmitter. The defective filter on 126.2 MHz was attenuating all signals by 14 dB or more. EMI on this frequency increased significantly when this defective filter was bypassed. The external interference noted at the GATR site during the May 1978 station evaluation was not observed during this evaluation.

(b) The following interim corrective actions are recommended to minimize the EMI on the VHF receivers.

1. Reassign frequencies 121.5 MHz to antenna A, 126.2 MHz to antenna C, and 121.8 MHz to antenna E (see Attachment 3). This configuration provides maximum physical separation for 121.5 MHz and 121.8 MHz to partially compensate for the extremely small frequency separation. The 16 foot separation for the 126.2 MHz and 121.8 MHz antennas is recommended because these are the most used primary frequencies. The 121.5 MHz and 126.2 MHz antennas remain relatively close together but RF bandpass filtering and low usage of 121.5 MHz would minimize interference.

2. All three VHF antennas/receivers should be provided with DB-4015 bandpass filters. The defective filter on 126.2 MHz should be replaced and an additional filter installed for 121.5 MHz. The single cavity bandpass filter can only provide a maximum of 6 dB attenuation for mutually interfering signals between 121.5 MHz and 121.8 MHz. The filters can, however, provide significant protection for the 126.2 MHz receiver from interference at 121.5 MHz or 121.8 MHz. The RF bandpass filters on 121.5 MHz and 121.8 MHz would likewise provide protection from interference at 126.2 MHz. The rotatable coupling loops on all DB-4015 bandpass filters should be set to the 2 dB attenuation position. This will provide over 30 dB attenuation of an interfering signal which is 4.4 MHz or more away from the filter center frequency while incurring only a 2 dB loss at the center frequency (see page A12-5). A review of the 1978 TRACALS Station Evaluation Report as well as analysis of the current TRACALS evaluation data indicates that this additional loss due to the filter settings would not adversely affect required communications coverage.

3. Transmit power on 121.5 MHz should be reduced from 50 watts to 10 watts. This reduction in transmit power would significantly reduce interfering signal levels for the two other VHF receivers. Communication coverage in the 10 watt mode, as indicated by the previous and current TRACALS evaluations, exceeds the requirements of AFM 55-8, United States Flight Inspection Manual. Additionally, a 25 watt multichannel VHF radio in the control tower provides backup capability at Keesler AFB, and the approach control facility at Gulfport Airport also uses this emergency frequency. In a 6 February 1979 letter to 1866 FCS, HQ AFCC/EPPT stated that local commanders may reduce the RF power levels if local circumstances so dictate.

(c) It should be noted that only a temporary waiver has been granted to collocate the UHF/VHF ATC remoted facilities. A permanent solution to this EMI problem must be found before final waivers may be granted (reference 1842 EEG/EEIM Msg 161218Z Aug 78). Additional support is needed to engineer a permanent solution to the EMI at the GATR site. Among possible solutions are a second antenna tower/pole at the GATR site to provide additional physical separation of antennas. This antenna tower/pole would also allow installation of a spare VHF antenna and provide additional spacing for UHF antennas. Installation of in-line monolithic crystal filters or multicavity bandpass filters may also be used to reduce interference. A third method to reduce interference is to obtain new VHF frequency assignments to provide additional frequency separation.

b. Flight Phase. Analysis of data gained during the flight phase provides a three dimensional picture of the radiation pattern of the Keesler ATC communications system. Horizontal coverage data from the orbital tracks and vertical coverage data from the radial tracks allows a model of the radiation pattern to be developed. The horizontal and vertical coverage predictional methods used in the preparation of this report are described in Attachments 9 and 10.

(1) Horizontal Coverage. The two orbital tracks flown, one for the GATR site and one for the control tower, indicated horizontal coverage was adequate to meet the Keesler ATC communications requirements (see Attachment 23).

(a) RLOS coverage predictions at 2000 and 3000 feet are shown in Attachment 7. Actual coverage will generally exceed these predictions because diffraction effects will provide additional coverage beyond horizon screening. Communications RLOS coverage will also be extended as an aircraft's altitude increases. Weather conditions and multipath propagation can also increase or decrease communications coverage. Atmosphere refractive conditions during the flight phase were normal.

(b) A strong lobing structure was noted in the GATR site horizontal radiation pattern for the flight test frequency of 320.1 MHz. The most significant nulls in the radiation pattern can be seen at approximately 5°, 75°, and 125° (see page A23-2). This lobing structure was not evident on the control tower orbital track nor on the orbital tracks flown during the May 1978 TRACALS evaluation. The source of this lobing structure appears to be antenna interaction caused by the approximately one wavelength spacing of the five antennas along the eastern rail of the antenna platform. Moving 320.1 MHz from antenna B to antenna G at the GATR site would reduce the lobing structure for this frequency and provide more uniform coverage. Providing increased antenna separation by spacing only four antennas along the east and west sides of the antenna platform would also reduce antenna interaction and improve coverage. Although the effects of antenna interaction are difficult to predict, it is generally considered desirable to have at least a two wavelength separation between antennas. Additional information on antenna coupling and interaction can be found in RADC test reports RADC-TR-76-180, VHF/UHF Antenna-to-Antenna Coupling Test Report, June 1978 and RADC-TR-77-374, Experimental Validation of the Antenna Pattern Distortion Computer Program, December 1977.

(c) While antenna interaction produced some deep nulls in the horizontal radiation pattern, horizontal coverage was still adequate to meet the 15 NM coverage requirement for the control tower. The -90 dBm average signal level measured by the aircraft on the 30 NM orbit equates to an average signal level of -84 dBm at a 15 NM distance from the control tower. The lowest signal level measured on the orbital track was -99 dBm which equates to a signal level of -93 dBm at 15 NM. This -93 dBm signal level in the deepest of the nulls produced by the antenna interaction still meets the minimum signal level needs of an aircraft receiver at 15 NM. Horizontal coverage for the control tower backup communications exceeded that of the primary communications. Skyline screening did not affect coverage in any quadrant.

(2) Vertical Coverage. A discussion of the vertical radiation pattern and how it is formed is presented in Attachment 9. The predicted null locations

are given in Attachment 8. The vertical radiation patterns presented in Attachment 25 are extrapolated from the radial signal strength measurements given in Attachment 24. These radiation patterns are peculiar to the specific radial flown, but they are representative of the vertical radiation patterns on other radials with similar terrain and screening. No significant nulls were noted in the vertical radiation patterns on any of the radials flown. Analysis of radial flight data shows communications coverage extending well beyond 30 NM on all tracks flown. Communications coverage on lower UHF and VHF frequencies will generally exceed the measured values for 320.1 MHz. Although coverage on VHF frequencies is adequate, controllers should be aware that EMI generated by the collocated VHF transmitters may override transmissions from aircraft at approximately 10 NM or beyond. The Keesler AFB Control Tower, ATIS, PTD, and PMSV communications coverage meets the requirements of AFM 55-8, United States Standard for Flight Inspection.

APPENDIX IV

POWER SYSTEMS

1. System Description. Commercial and backup power is provided for the GATR site and control tower. Backup power is supplied by diesel powered generators. Automatic changeover equipment is installed to ensure continuous power should a commercial power failure occur.

2. Equipment Status. The backup generators at the GATR site and the control tower started and assumed load in 7 and 5 seconds respectively. Both generators were stable after warmup. Details of voltage and current measurements for primary and backup power at each facility are in Attachment 20.

3. Evaluation Overview:

a. The objective of this evaluation was to determine the adequacy and reliability of the power systems, both commercial and backup, with respect to the ATC communications needs. Sufficient data was collected to determine:

(1) If commercial and backup power was stable and within the design specifications of the installed communications equipment?

(2) If the time interval between loss of commercial power and the assumption of the electrical load by the backup generators was within limits?

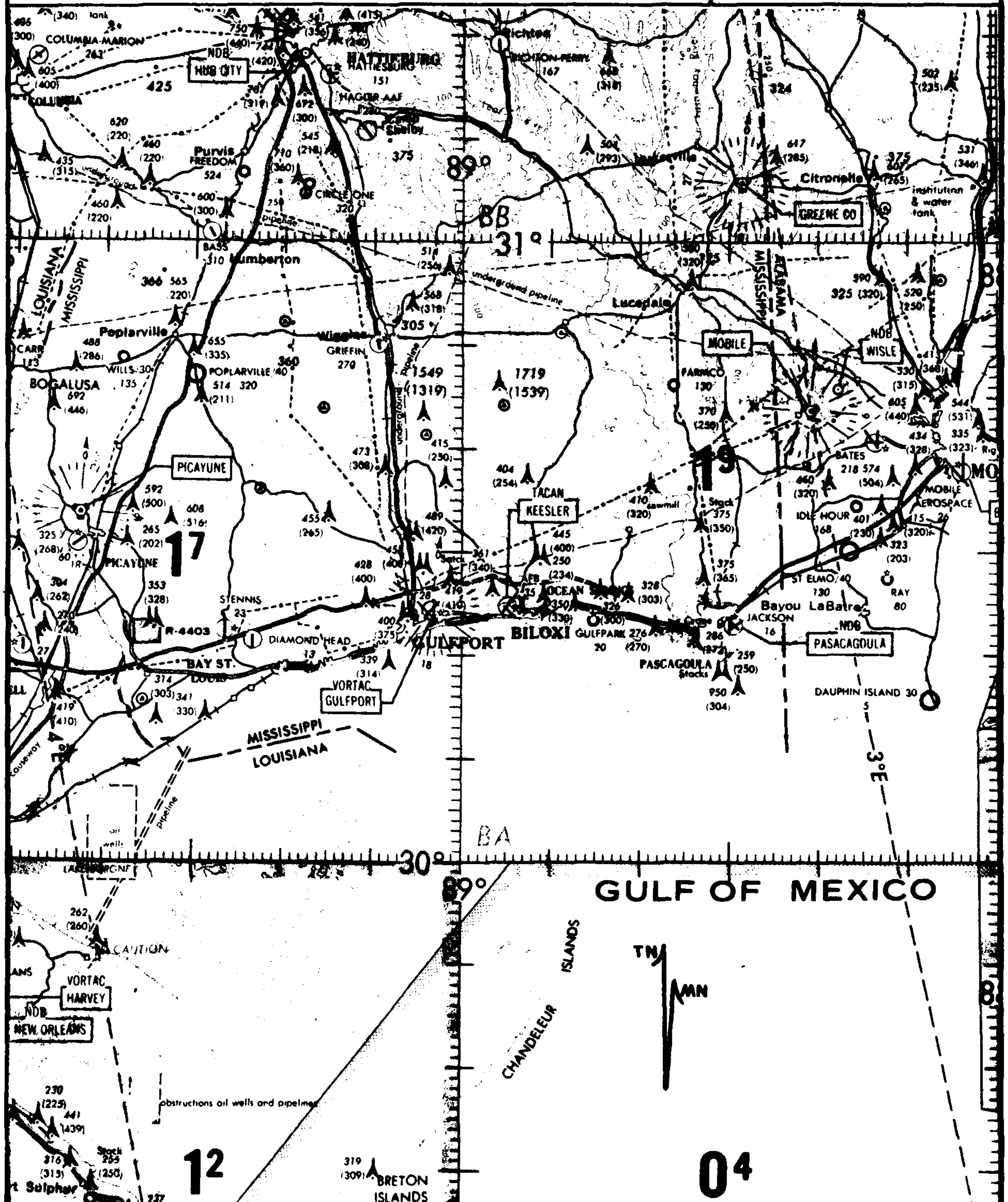
b. Power changeover interval was timed following a simulated commercial power failure. Voltage and current measurements were made using a clamp-on volt-amp meter. Backup power was allowed to operate for at least 10 minutes and was checked for stability.

4. Analysis of Evaluation. Commercial and backup power for both ATC communications facilities was adequate, stable and reliable. The backup generators started and assumed the load in an excellent time interval following the simulated power failure.

TITLE:

GEOGRAPHIC LOCATION

LOCATION	DATE
Keesler AFB	March 1980



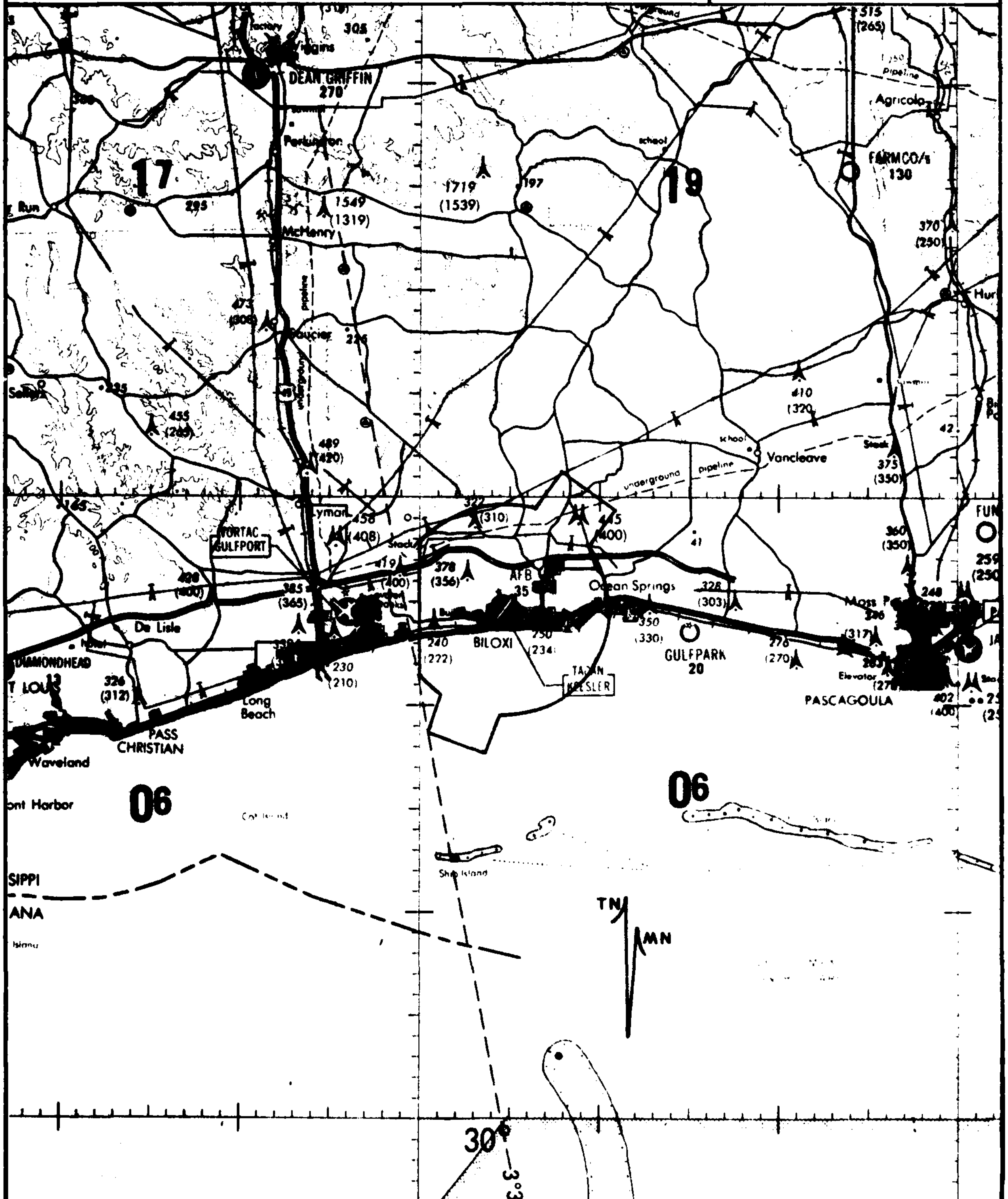
REMARKS

Scale: 1:1,000,000 Magnetic Variation: 4° East

TITLE:

CONTROL ZONE

LOCATION	DATE
Keesler AFB	March 1980



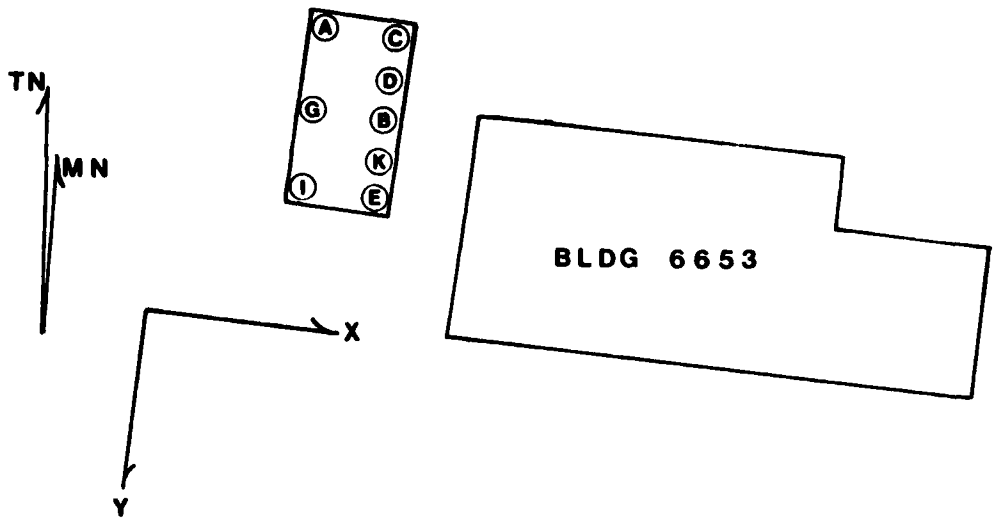
REMARKS

Scale: 1:500,000 Magnetic Variation: 4° East

TITLE:

GATR SITE ANTENNA LAYOUT/DATA

LOCATION	DATE
Keesler AFB	March 1980



ANTENNA NUMBER**	ANTENNA COORDINATES (ft) X	Y	Z(AGL)	ANTENNA TYPE	FREQ (MHz)
A/6*	0.00	0.00	66.0	AS-1181	121.8
B/8	8.40	7.90	66.0	AS-1097	236.6/320.1/ 271.8/349.4
C/1	8.40	0.00	66.0	AS-1181	126.2
D/7	8.40	3.90	66.0	AS-1097	372.2/344.6/ 243.0/275.8
E/3	8.40	15.00	66.0	AS-1181	121.5
G/5	0.00	7.40	66.0	AS-1097	SPARE
I/4	0.00	14.90	66.0	AS-1097	SPARE
K/2	8.40	11.50	67.2	AT-197	SPARE

* Reference Antenna
** Antenna numbers are listed as letters and numbers because of the erratic labeling of the transmission lines at the site and on the Plant In Place records.

REMARKS

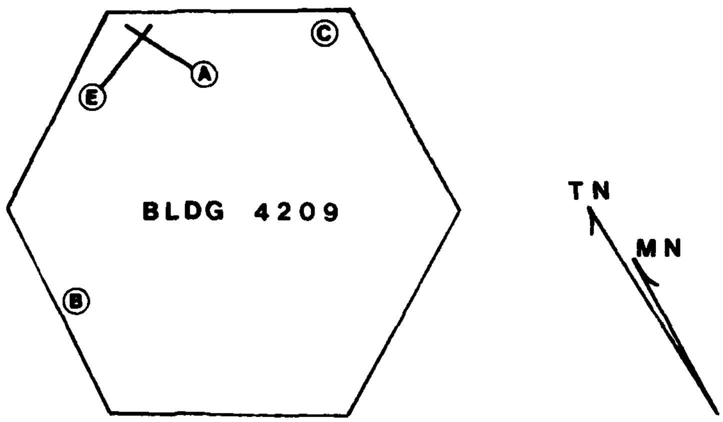
Site Elevation: 21 feet MSL

TITLE:

CONTROL TOWER ANTENNA LAYOUT/DATA

LOCATION: Keesler AFB

DATE: March 1980

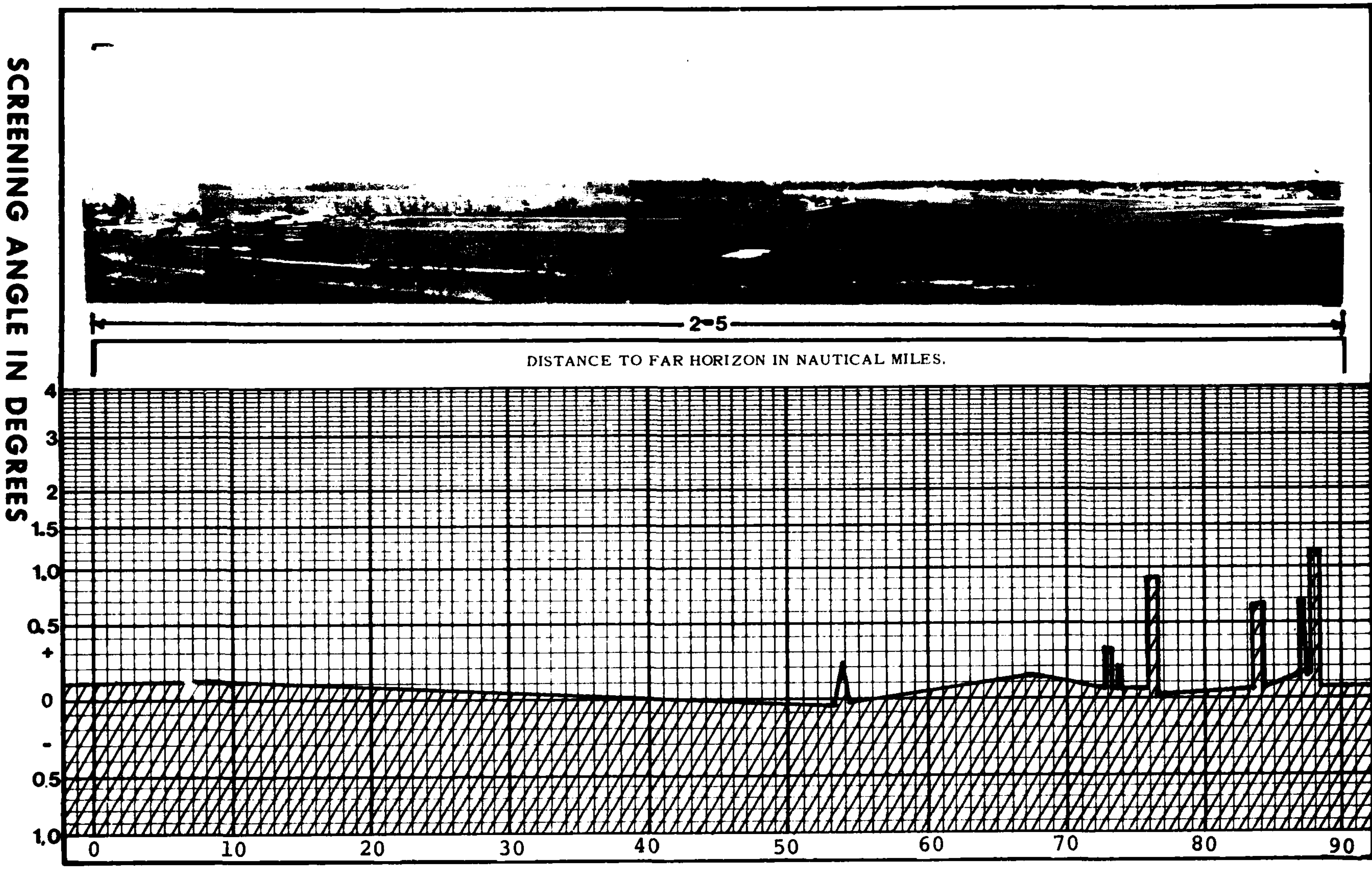


ANTENNA NUMBER	ANTENNA TYPE	FREQ (MHz)/ EQUIPMENT
A	AT-197	GRC-171 UHF MULTICHANNEL
B	AS-1181	GRC-175 VHF MULTICHANNEL
C	AS-1181	126.2
E	AS-197	320.1

REMARKS

Site Elevation: 21 feet MSL

SKYLINE GRAPH



ORIENTED TO: MAGNETIC NORTH

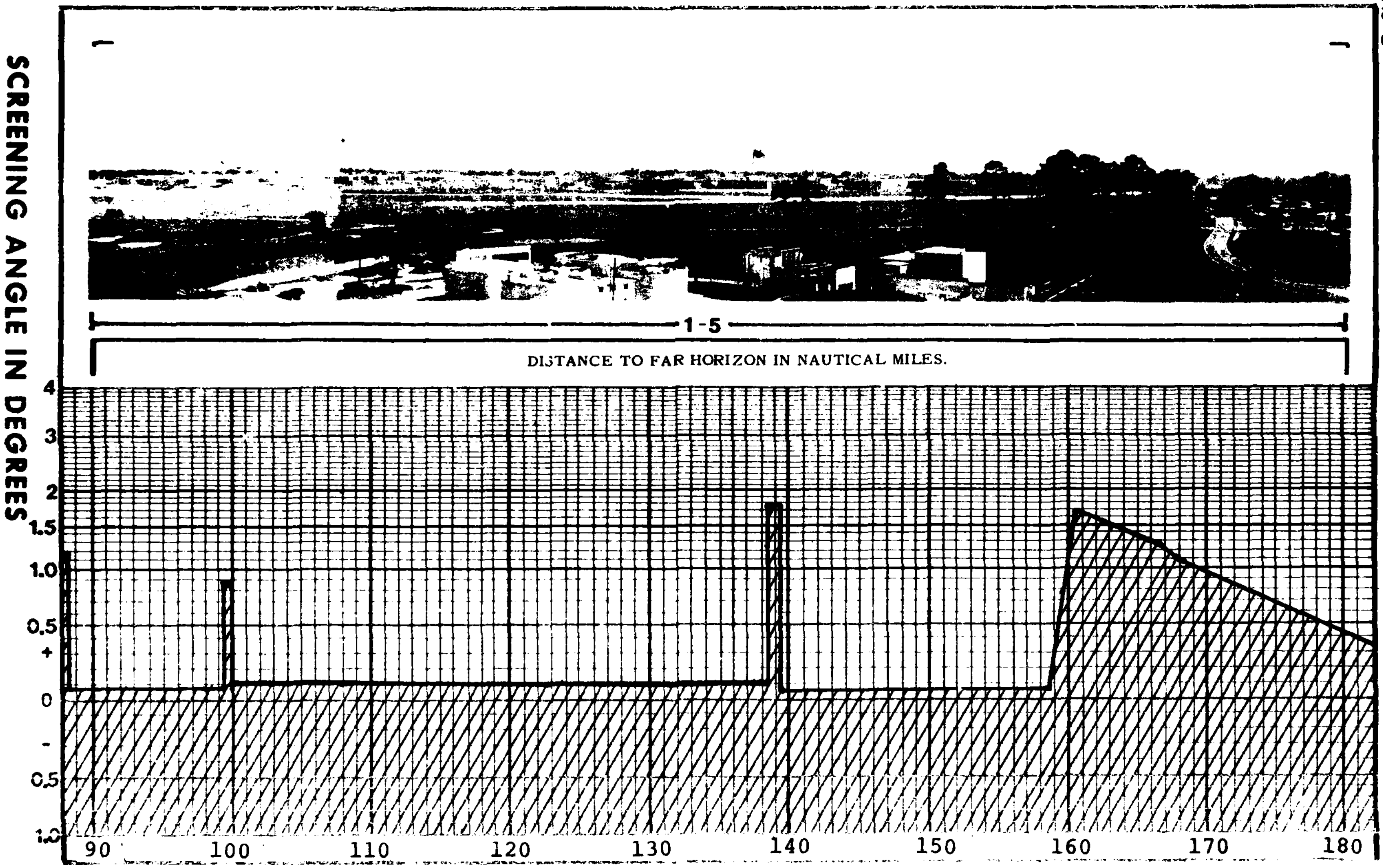
MAGNETIC VARIATION 4°E

STATION KEESLER AFB

EQUIPMENT GATR SITE

AFCS FORM 913

SKYLINE GRAPH

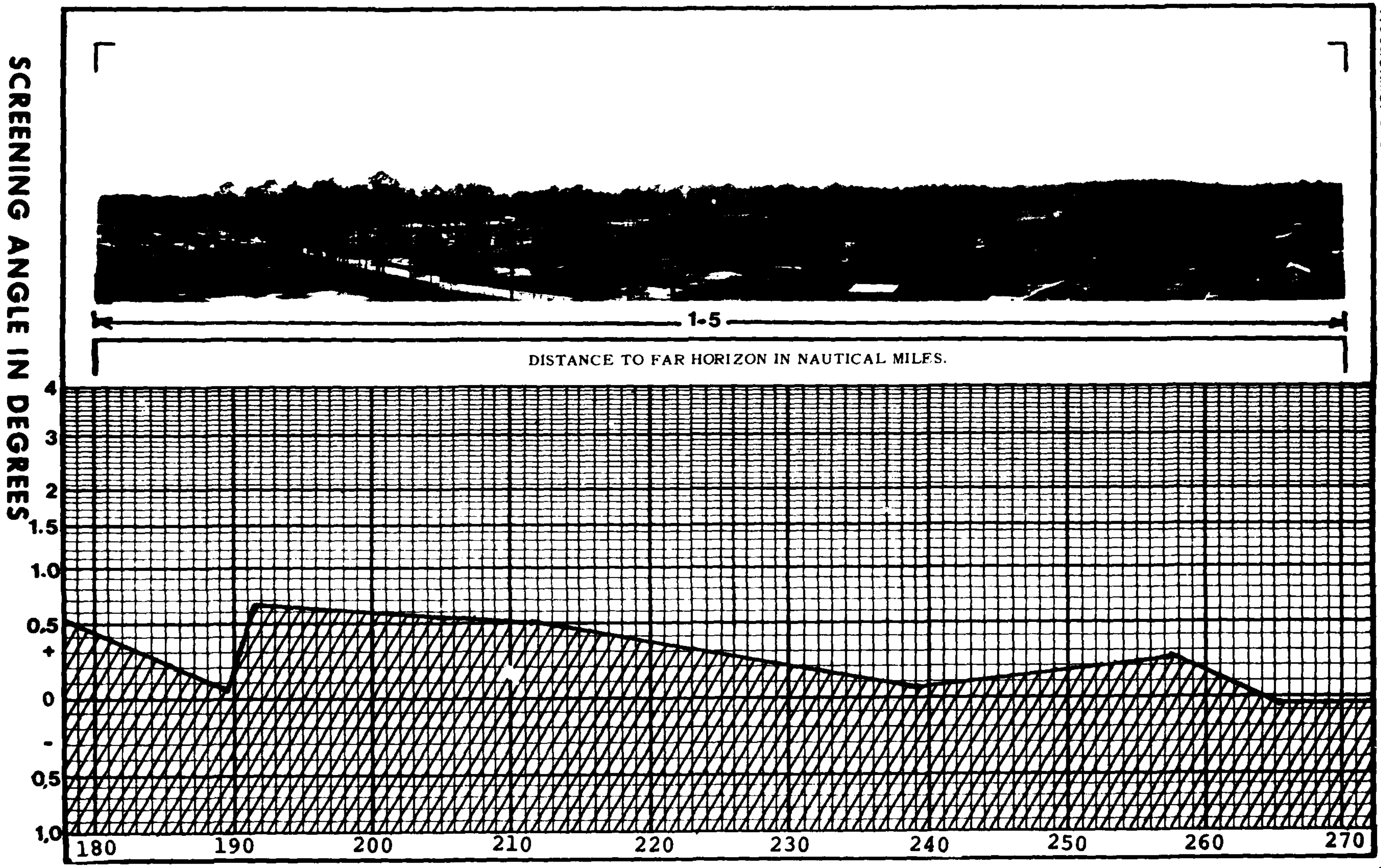


ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION $4^{o}E$

AFCS FORM MAY 73 913

STATION KEESLER AFB
EQUIPMENT GATR SITE

SKYLINE GRAPH

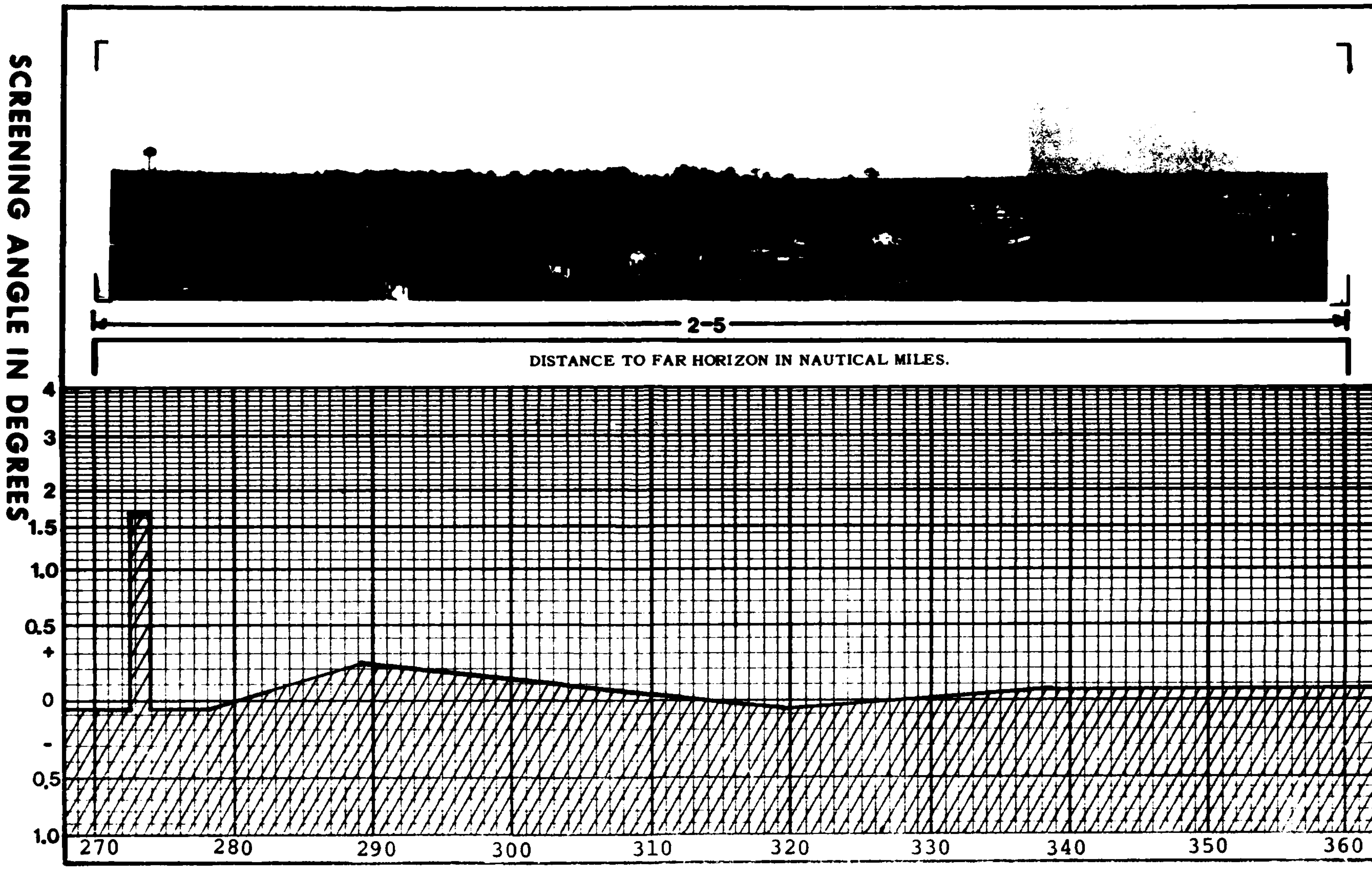


ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION $4^{O}E$

STATION KEESLER AFB
EQUIPMENT GATR SITE

AFCS FORM MAY 71 913

SKYLINE GRAPH

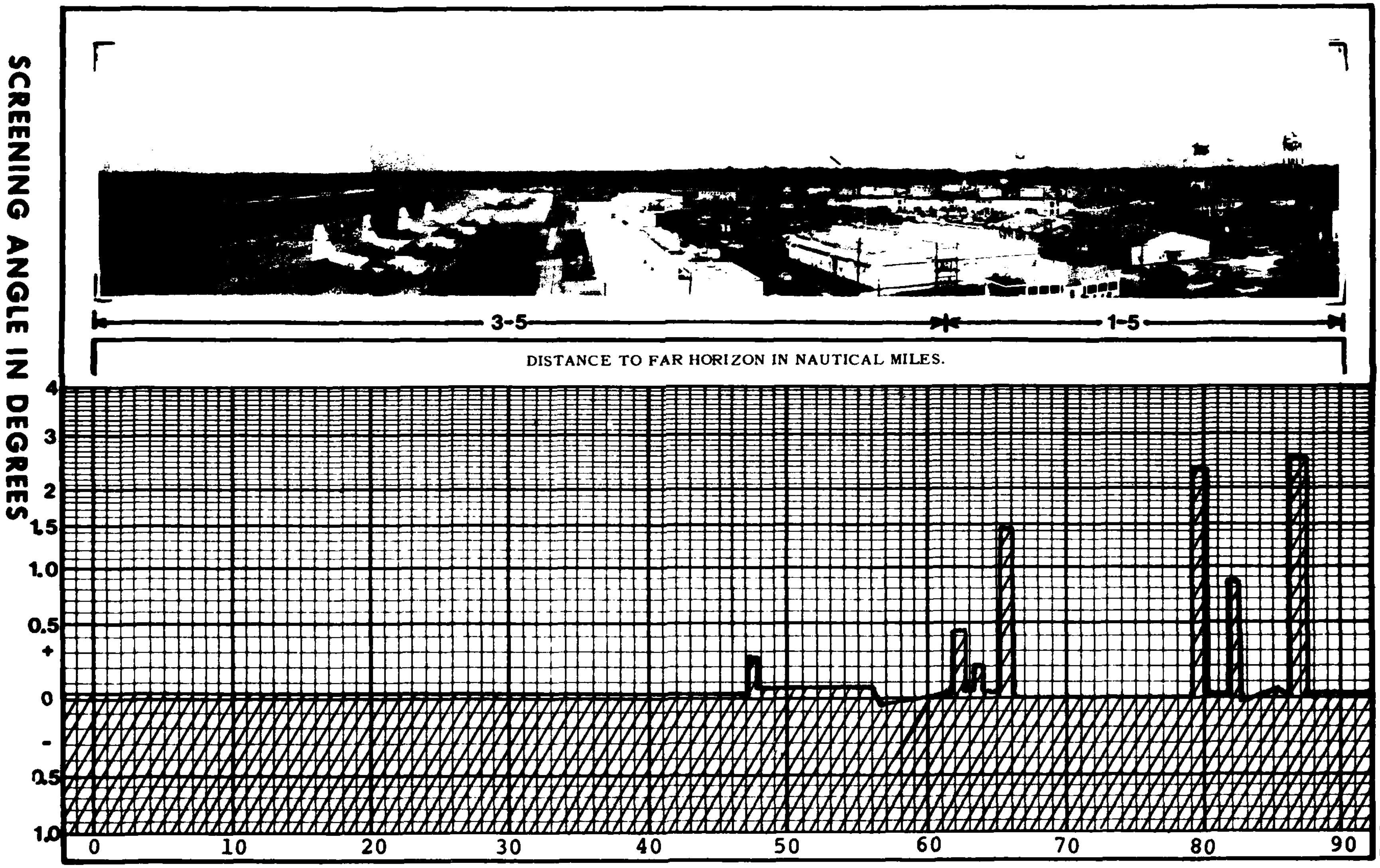


ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION $4^{O}E$

STATION KEESLER AFB
EQUIPMENT GATR SITE

AFCS 913

SKYLINE GRAPH



ORIENTED TO: MAGNETIC NORTH

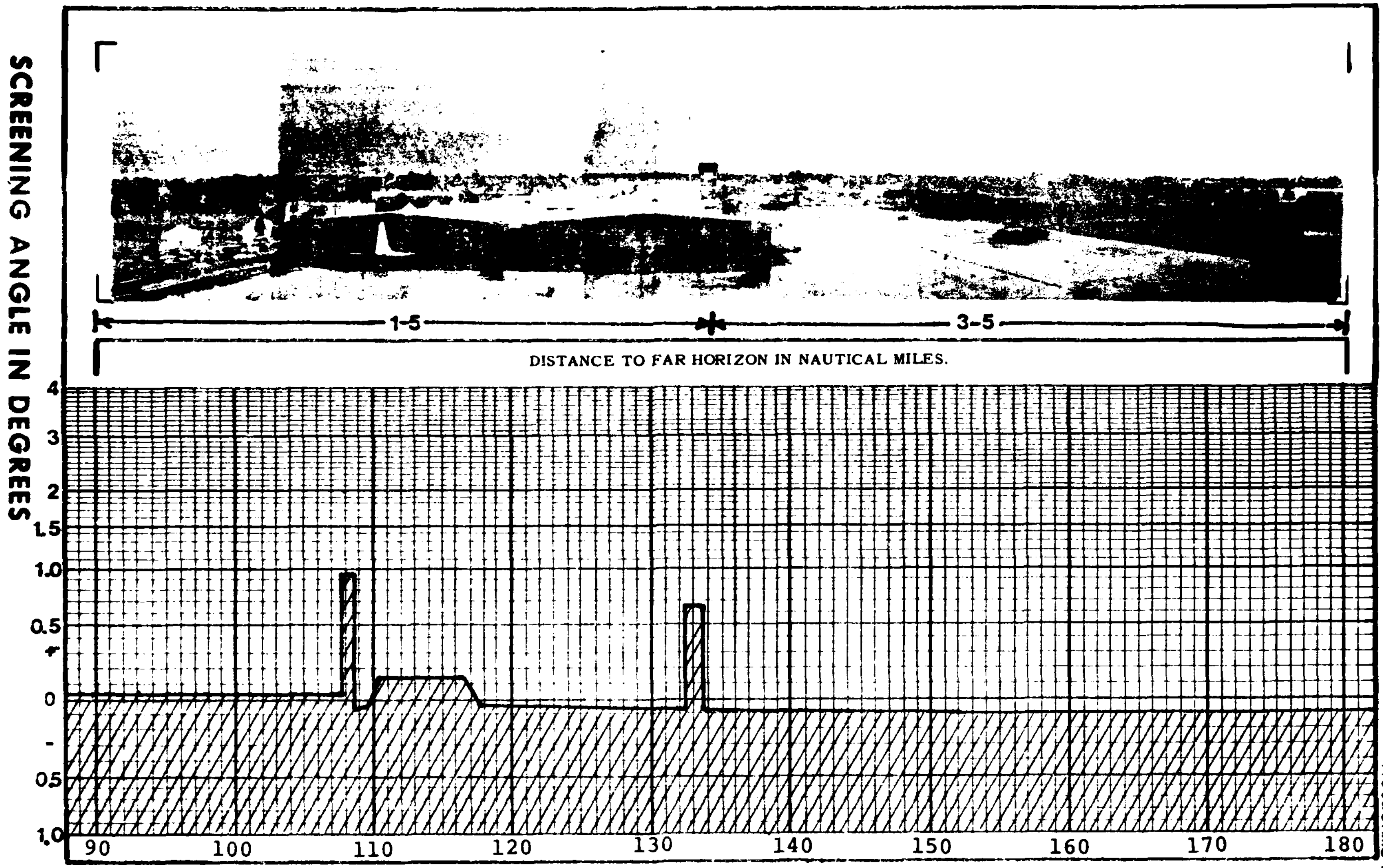
MAGNETIC VARIATION 4°E

STATION KEESLER AFB

EQUIPMENT CONTROL TOWER

AFCS FORM 913

SKYLINE GRAPH



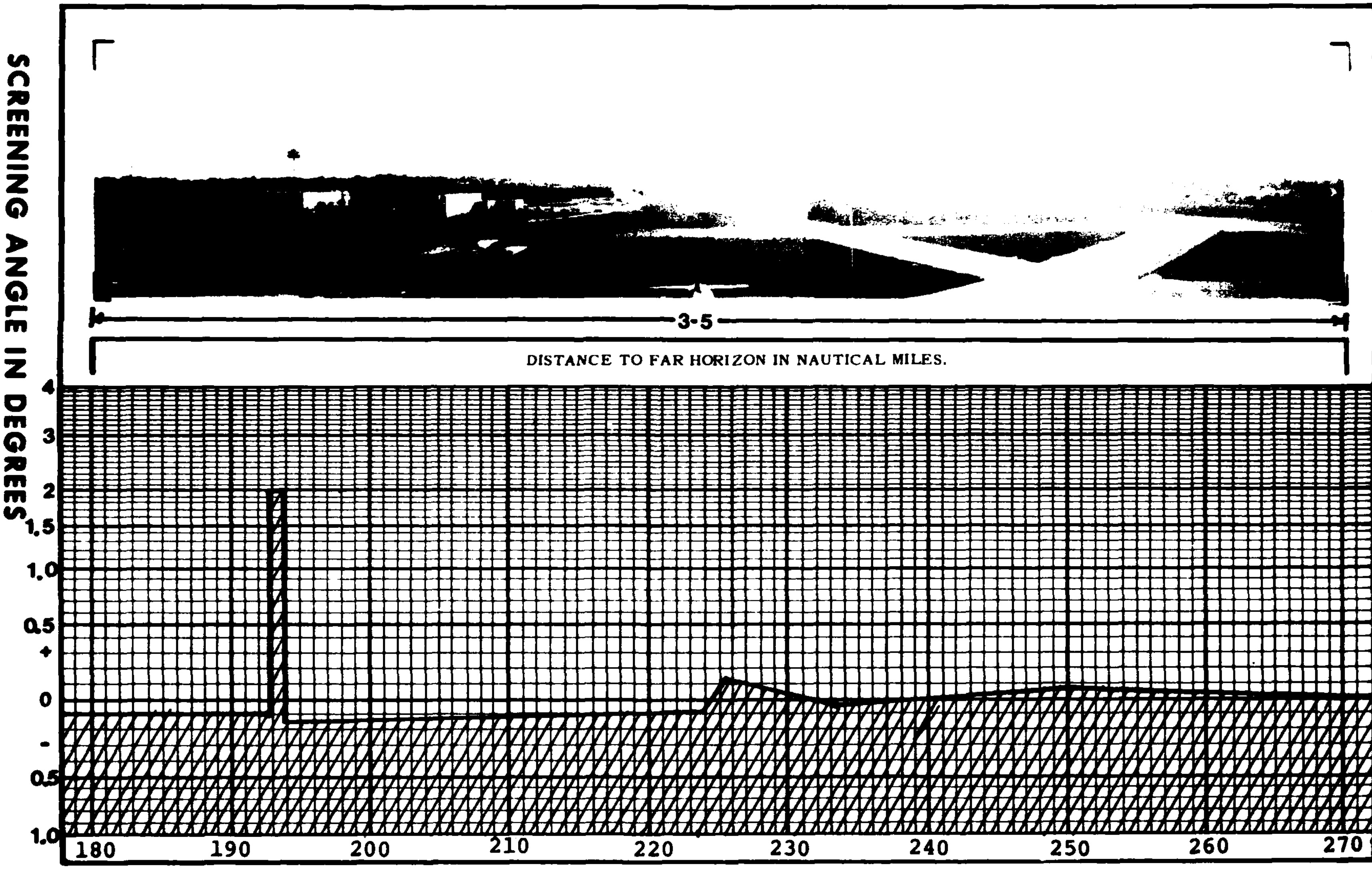
ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION 4^{O}E

STATION KEESLER AFB

EQUIPMENT CONTROL TOWER

AFCS FORM MAY 73 913

SKYLINE GRAPH

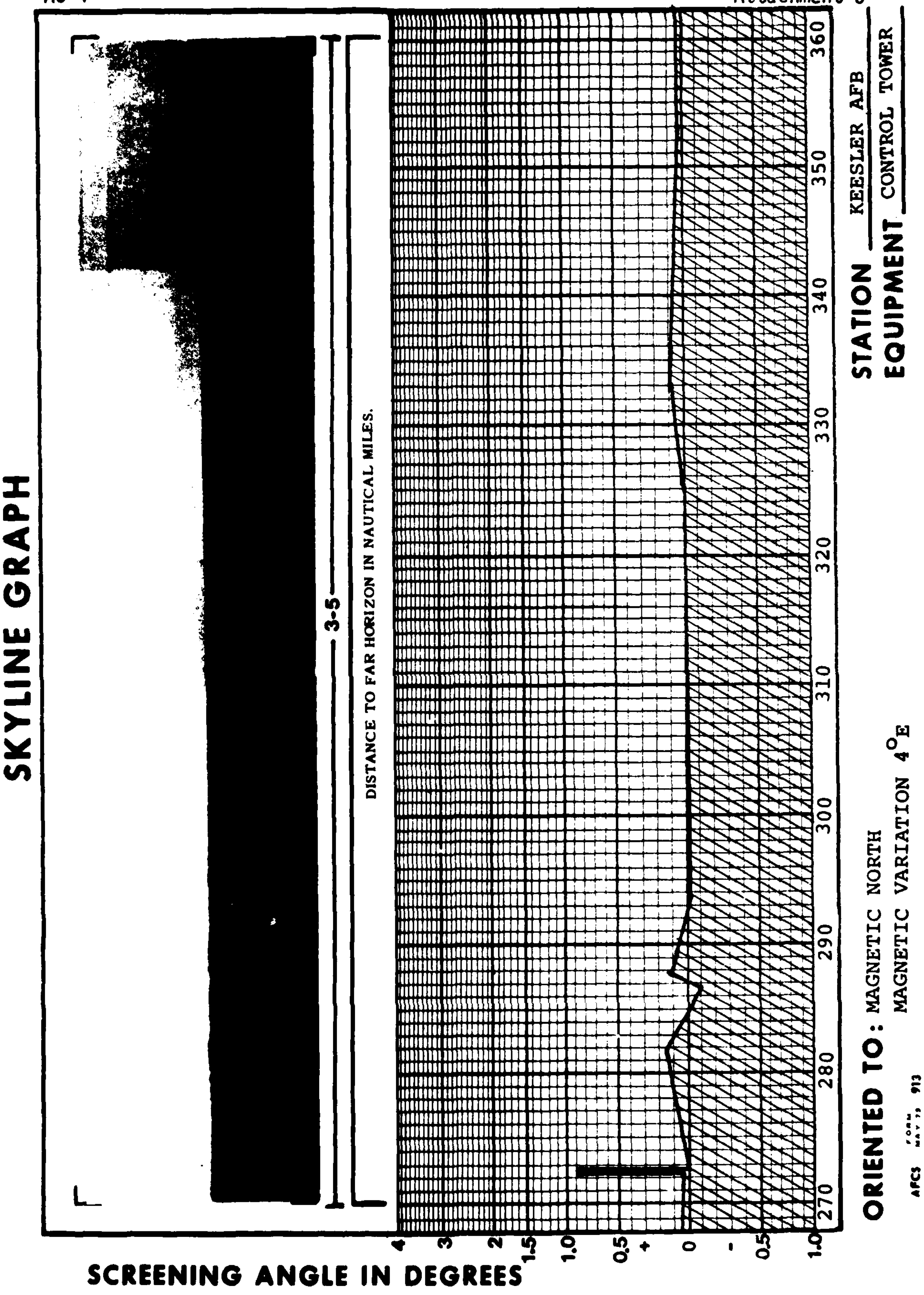


ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION $4^{O}E$

STATION KEESLER AFB

EQUIPMENT CONTROL TOWER

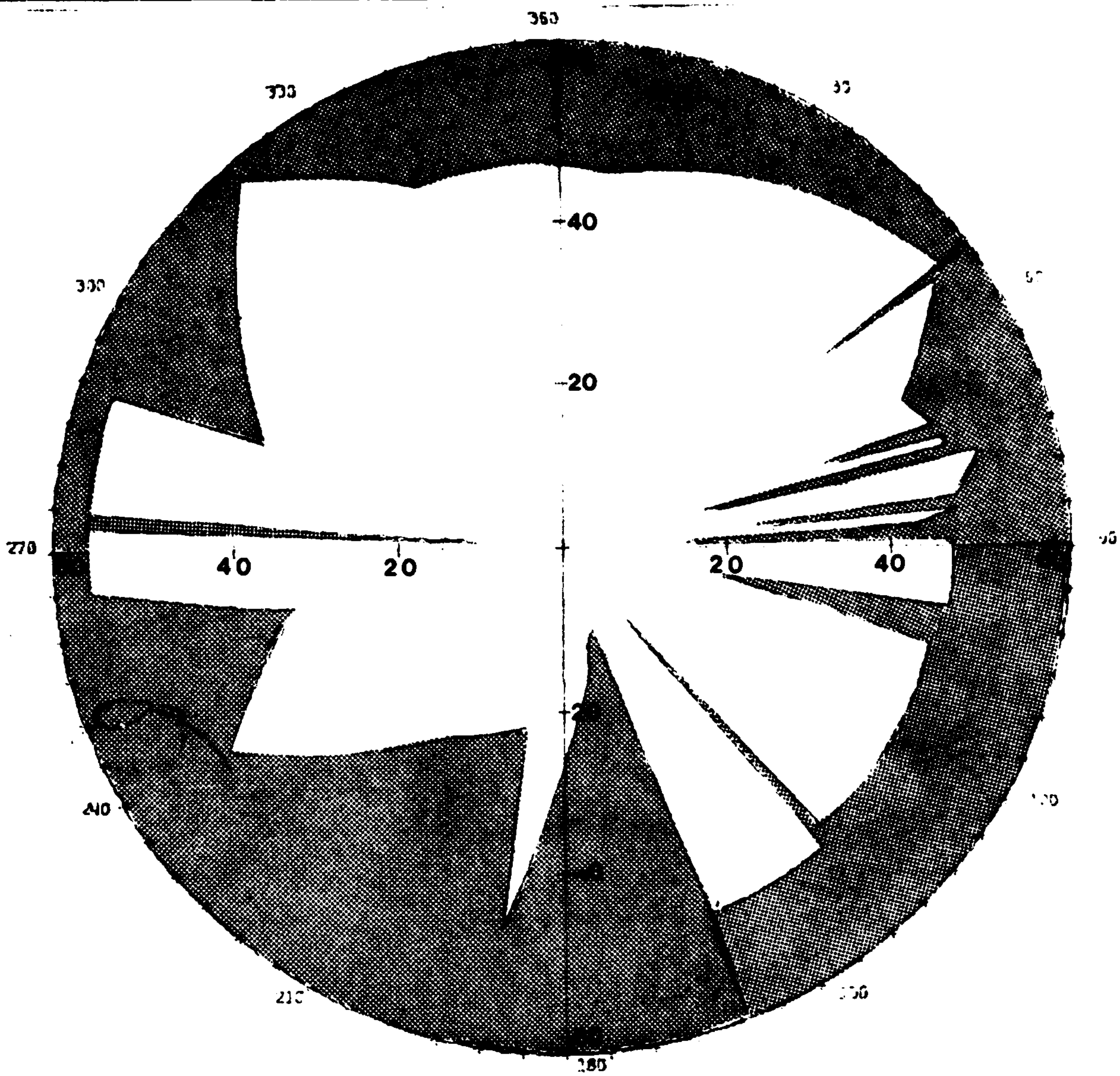
AFCS FORM MAY 73 913


SKYLINE GRAPH
3-5
DISTANCE TO FAR HORIZON IN NAUTICAL MILES.
270
280
290
300
310
320
330
340
350
360
4
3
2
1.5
1.0
0.5
+
0
-
0.5
1.0
SCREENING ANGLE IN DEGREES
STATION KEESLER AFB
EQUIPMENT CONTROL TOWER
ORIENTED TO: MAGNETIC NORTH
MAGNETIC VARIATION 4°E
AFCS FORM MAY 73 913

TITLE:

RLOS RANGE

LOCATION	DATE
Keesler AFB (GATR Site)	March 1980



KEESLER AFB
GATR SITE
15 MAR 80
ANTENNA ELEVATION 88 FT MSL
SCALE: 1 INCH = 20 NM
ORIENTED TO MAGNETIC NORTH

ALTITUDES FT. MSL
2000

VARIATION 4 DEG E

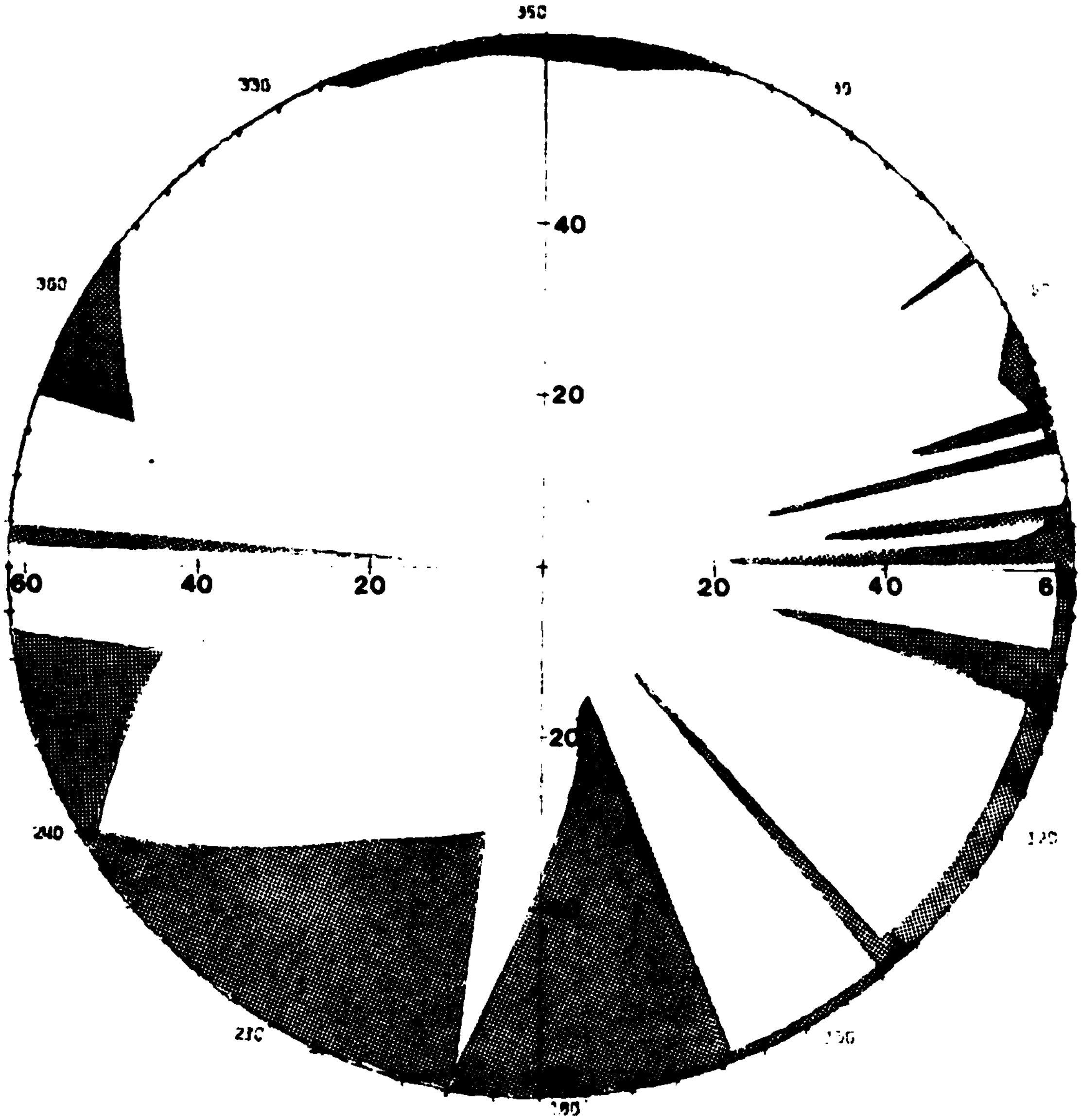
REMARKS

Shaded areas represent coverage limitations due to RLOS screening.

TITLE:

RLOS RANGE

LOCATION		DATE
Keesler AFB	(GATR Site)	March 1980



KEESLER AFB
GATR SITE
15 MAR 80
ANTENNA ELEVATION 88 FT MSL
SCALE: 1 INCH = 20 NM
ORIENTED TO MAGNETIC NORTH

ALTITUDES FT. MSL
3000

VARIATION 4 [illegible]

REMARKS

Shaded areas represent coverage limitations due to RLOS screening.

TITLE:

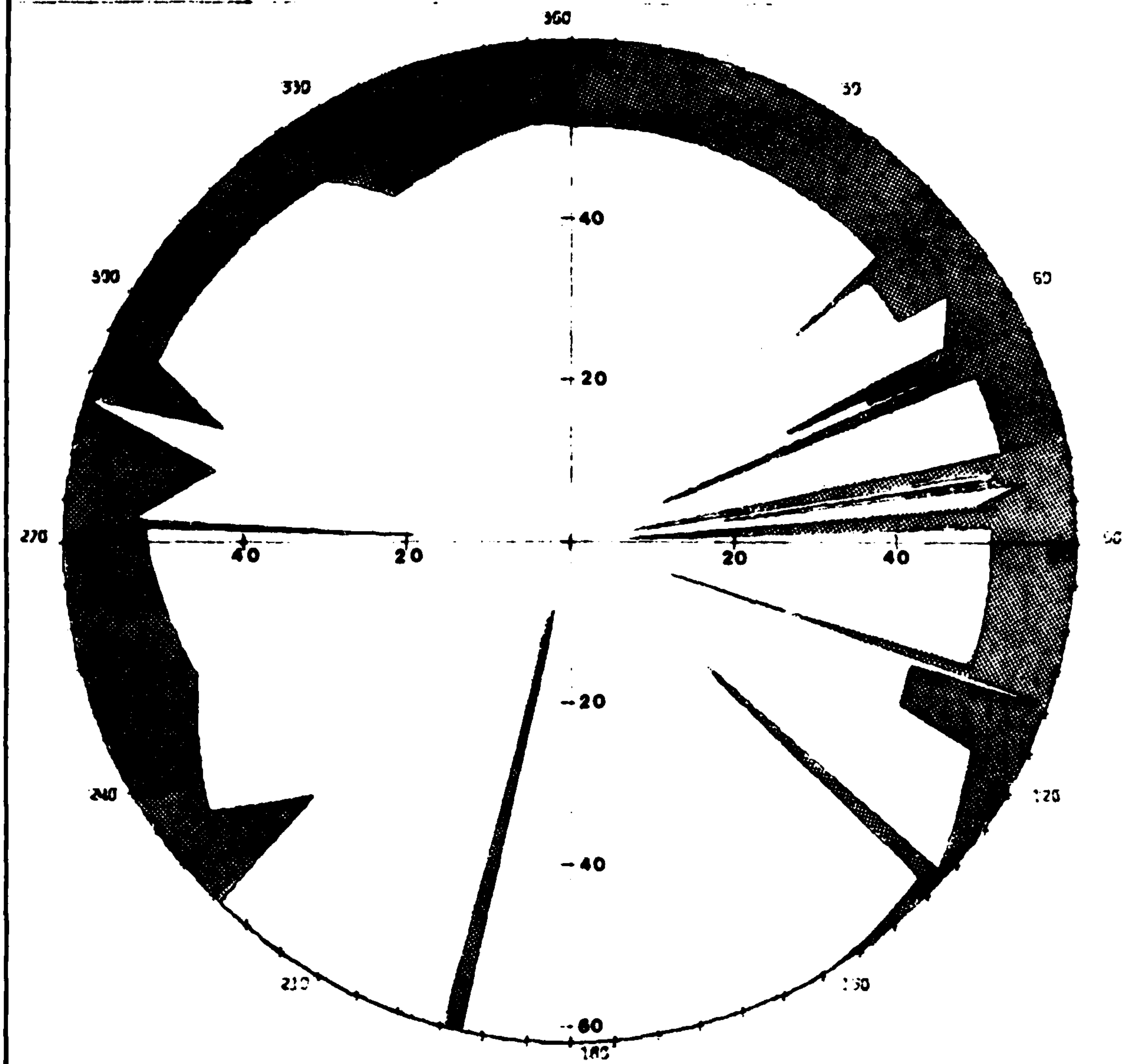
RLOS RANGE

LOCATION

Keesler AFB (Control Tower)

DATE

March 1980



KEESLER AFB
CONTROL TOWER
15 MAR 80
ANTENNA ELEVATION 72 FT MSL
SCALE: 1 INCH = 20 NM
ORIENTED TO MAGNETIC NORTH

ALTITUDES FT. MSL
2000

VARIATION 4 DEG E

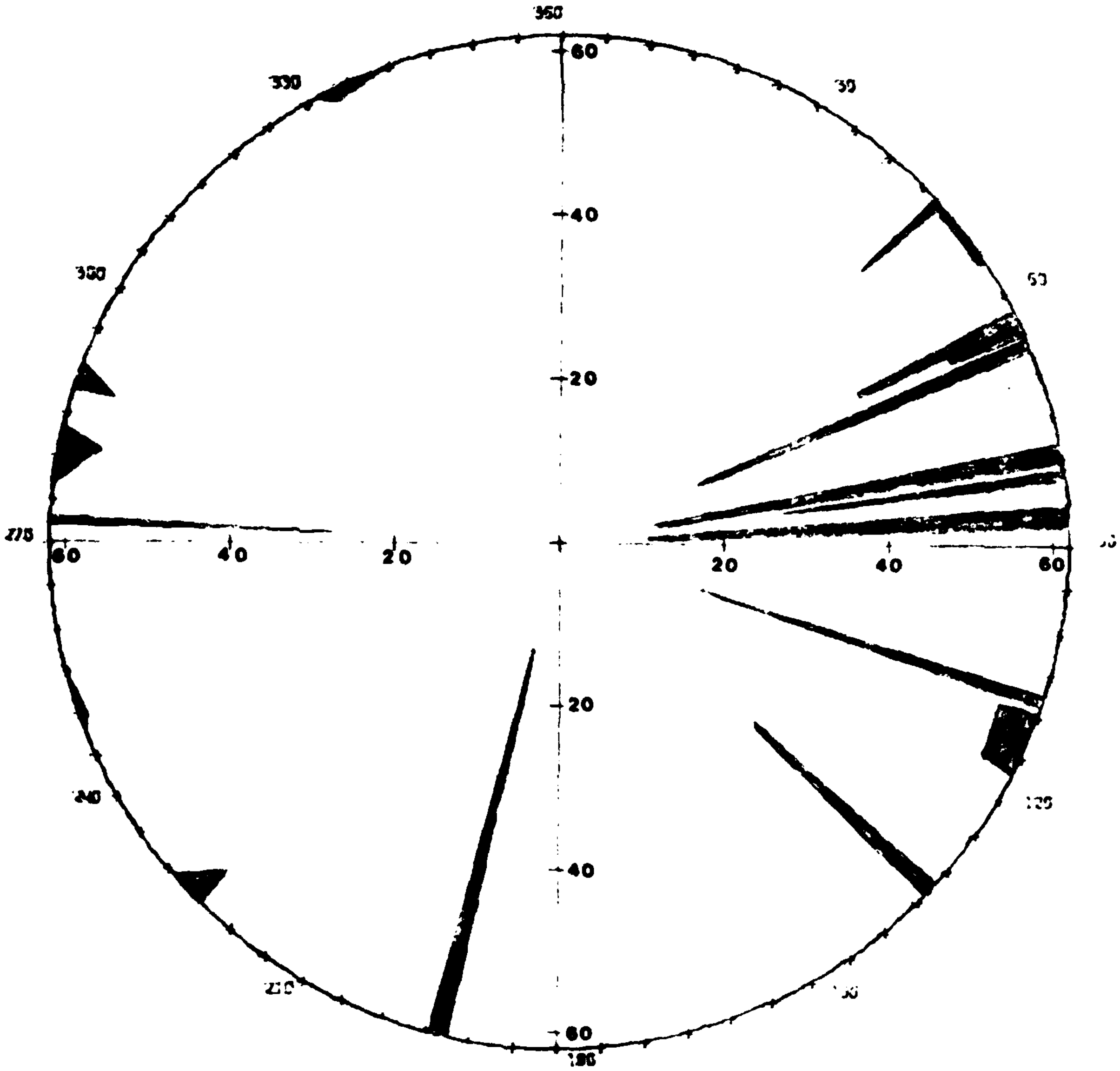
REMARKS

Shaded areas represent coverage limitations due to RLOS screening

TITLE:

RLOS RANGE

LOCATION	DATE
Keesler AFB (Control Tower)	March 1980



KEESLER AFB
CONTROL TOWER
15 MAR 80
ANTENNA ELEVATION 72 FT MSL
SCALE 1 INCH = 20 NM
ORIENTED TO MAGNETIC NORTH

ALTITUDES FT. MSL
3000

VARIATION 4 DEG E

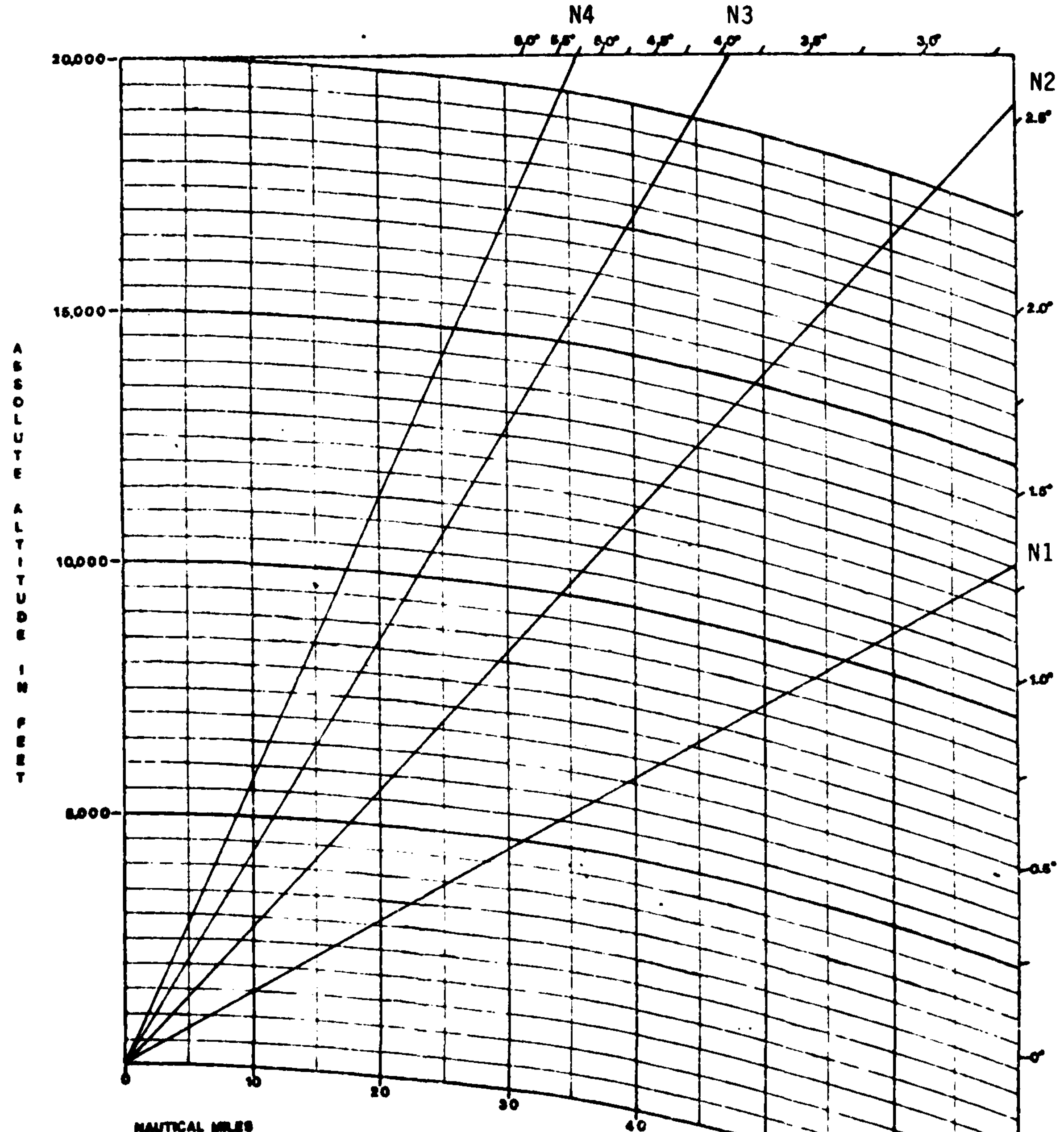
REMARKS

Shaded areas represent coverage limitations due to RLOS screening

TITLE

UHF NULL LOCATIONS

LOCATION		DATE
Keesler AFB	(GATR Site)	March 1980



$$\theta = \frac{14098n}{Ha\ F} \qquad n = 2, 4, 6, \ldots$$

θ = Null angle in degrees
F = Frequency (MHz) = 320.1
Ha = Antenna height above reflecting terrain = 66 feet AGL

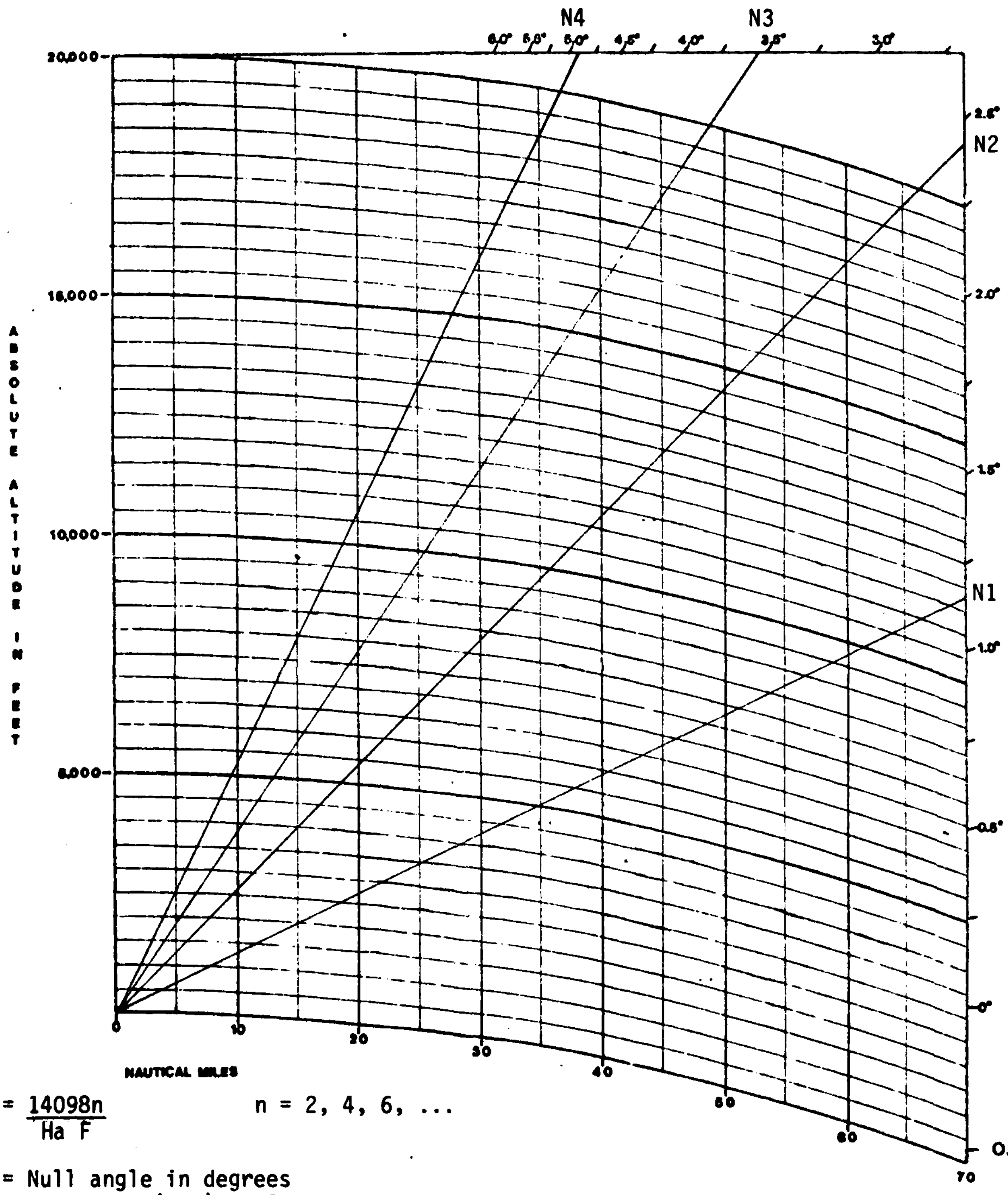
REMARKS

N1 through N4 = Predicted null angles

TITLE

UHF NULL LOCATIONS

LOCATION: Keesler AFB (Control Tower) | DATE: March 1980



$$\theta = \frac{14098n}{H_a\ F} \qquad n = 2, 4, 6, \ldots$$

θ = Null angle in degrees
F = Frequency (MHz) = 320.1
Ha = Antenna height above reflecting terrain = 73 feet AGL

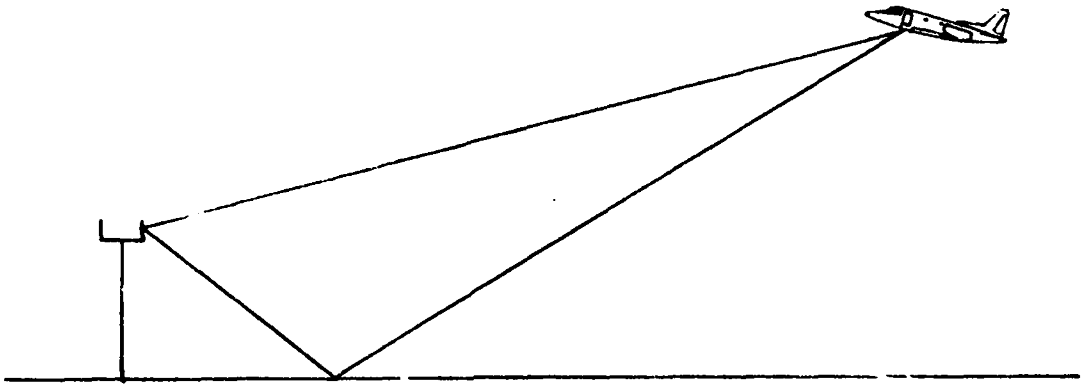
REMARKS

N1 through N4 = Predicted null angles

TITLE:

VERTICAL RADIATION PATTERN PREDICTION

1. The vertical radiation pattern is a function of the interference field which consists of a series of maximum and minimum signal strength areas commonly referred to as lobes and nulls, respectively. Multipath propagation causes the interference field to form. The transmitted signal travels over two or more paths, one directly from the transmit antenna to the receive antenna, and the others from the transmit antenna to ground reflection points and then to the receive antenna. The path lengths of the reflected rays are always longer than the direct ray, causing a phase angle difference at the receive antenna. Lobes form when the direct and reflected signal combine in phase (0° phase difference). Out of phase (180° phase difference) combination of direct and reflected signals will cause the formation of nulls.



2. Null angles may be calculated using the formula:

$$\theta = \frac{14098\,n}{Ha\,F} \qquad n = 2,4,6,\ldots\ldots$$

Where θ = null angle in degrees
F = frequency in MHz
Ha = antenna height above terrain in feet

3. The aircraft's high angle of attack and the airborne receiving antenna location (center, bottom of fuselage) cause an overall reduction in signal strength on outbound tracks. Therefore, nulls are more pronounced in the RSL and radiation pattern plots constructed from data collected while flying away from the facility. The nulls appear as sharp reductions in signal strength on the RSL plots and areas of degraded coverage on the vertical radiation plots. The vertical radiation patterns which follow were calculated using the RSL data measured on radial tracks. The predicted null locations, which may represent areas of unacceptable communications, are plotted in the preceding Attachment. The measured null locations, as represented on the RSL and vertical radiation plots usually correlate closely with the predicted null locations on the radials flown.

TITLE:

HORIZONTAL COVERAGE PREDICTION

Communications coverage predictions can be divided into two areas, RLOS range and free space loss. The RLOS predictions are based on the surveyed horizon screening angles and the radio horizon with standard refractive conditions. Predicted RLOS range is derived from the following equation:

$$R = \frac{-160a + \sqrt{(160a)^2 + 4(A-E)(1.507784)}}{2}$$

a = Screening angle
R = Range (NM)
A-E = Difference between transmit and receive antenna heights (ft AGL)

The RLOS plots generated using this formula are a worst case prediction of communications range, but can be useful in determining areas of coverage degradation. In reality, communications coverage is usually ten to thirty percent better than RLOS predictions because of ray diffraction beyond the horizon screens. The RSL predictions are based upon free space loss and the logarithmic characteristics of RF propagation. The area beyond the screening object and below the horizon screening angle is commonly referred to as the shadow zone. In this area, coverage can be more accurately predicted by computing range as a function of minimum RSL. Minimum acceptable RSL is the lowest level at which the ground or airborne receiver squelch circuit will activate. The receiver squelch level for flight inspection aircraft is calibrated to -93 dBm; however, the majority of newer aircraft receivers in the Air Force inventory are calibrated to -97 dBm. The ground receiver squelch level is -97.5 dBm for the AN/GRR-23/24/25 receivers. Therefore, most aircraft and all ground receivers are capable of detecting audio on a carrier level of -97.5 dBm or greater. RSL is calculated by equating system losses, antenna gains, and transmit power as follows:

$$RSL = P + G - L - 20\log(f) - 20\log(r) - 37.8$$

Where P = Transmitter output power (dBm)
G = Antenna gain (dBi)
L = Coupler loss and transmission line loss (dB)
f = Frequency (MHz)
r = Range (NM)

The quantity 37.8 is an accumulation of scaling factors for range in nautical miles, frequency in megahertz, and conversion of RSL from microvolts to dBm.

TITLE:

REFRACTIVE THEORY

1. The bending or refraction of electromagnetic energy as it passes through the air occurs because of the structure of the troposphere. Energy propagated through a vacuum would travel in a straight line. Similarly, energy transmitted through any gas (or liquid) that is uniform in density perpendicular to the direction in which the energy is traveling, will follow a straight line path. However, due to the physical characteristics of the troposphere, the density of the troposphere decreases with increasing height. Therefore, the front of energy transmitted at low elevation angles will be subject to refractive bending. Usually, the top of the wave front will move faster than the bottom, since the density of the atmosphere decreases with height. The result is a downward bending of the transmitted energy.

2. The number that describes the relative speed of propagation in any substance is referred to as the index of refraction (n). It is defined as the ratio of the speed of propagation of electromagnetic energy in a vacuum (c) to the speed of propagation of electromagnetic energy in the medium in question (v):

$$n = \frac{c}{v}$$

Within the wavelength band from 1 cm (30 GHz) to 10 meters (30 MHz), the index of refraction does not change appreciably as the frequency changes. The typical range of values of n at sea level is from 1.000250 to 1.000450. Since these numbers are difficult to work with, a "scaled up" quantity called refractivity (N) is used and is defined as:

$$N = (n - 1)\, 10^6$$

Thus, the range of values of refractivity at sea level becomes 250 to 450 N-units.

3. As mentioned earlier, the bending of energy is caused by the change in density with height in the air. Since the speed of propagation of energy is related to the density of the air, and the refractivity (N) is related to the speed of propagation of energy (by definition), then refractivity in the troposphere is directly related to the density of the air. Therefore, the bending of electromagnetic energy may be thought of as due to the change of refractivity with height in the troposphere, or the vertical gradient of refractivity. It is important to note that it is not the value of N at a particular point that determines refraction, but it is the gradient of refractivity that must be considered. The refractivity may be related to the meteorological variables of pressure (p), temperature (T), and water vapor pressure (e) by the following equation:

$$N = \frac{Ap}{T} + \frac{Be}{T^2}$$

where A and B are constants. The normal rapid decrease of p and e with height in the troposphere leads to a decrease of N with height. Temperature usually

78-5071

TITLE:

REFRACTIVE THEORY

decreases slowly with height, and this has an opposite effect on the change of N. In the so-called "standard" atmosphere, the result is that N will decrease by about 12 N units per 1000 feet of altitude through the lower levels of the troposphere, and 6 N units per 1000 feet in the upper levels. It is this decrease of refractivity with height that leads to the "normal" downward curvature, or refraction, of electromagnetic energy.

4. In the "real" troposphere all is not so simple. The temperature and water vapor pressure may vary in any manner, while atmospheric pressure will continue to decrease with height. This seemingly random variation of the meteorological terms will lead to unusual changes in refractivity with height. Refractivity may decrease more than in the "standard" troposphere, causing more pronounced bending of electromagnetic energy. On the other hand, refractivity may actually increase with height, which may result in an upward curvature of a radio/radar beam (opposite the curvature of the earth). The propagation of electromagnetic energy along a path that is different from the usual or expected path is known as "anomolous propagation" (AP). The refraction that results under various AP conditions is referred to as either subrefraction, superrefraction, or trapping (ducting). These refractive conditions, the effects on electromagnetic energy presented as a single ray, and the gradients of refractivity that may cause them are defined below:

a. Subrefraction: Ray curvature is upward. Radio/radar ranges are significantly reduced. The occurence is quite rare. The gradient of refractivity is equal or greater than 0 N-units/1000 feet (average "standard" value is -12 N-units/1000 feet).

b. Normal Refraction: Ray curvature is downward but not as much as the curvature of the earth. Radio/radar performance is generally undisturbed, and the occurrence is frequent. The gradient of refractivity is less than 0 N-units/1000 feet and greater than -24 N-units/1000 feet.

c. Superrefraction: Ray curvature is downward, more sharply than normal, but not as much as the curvature of the earth's surface. Radio/radar ranges may be significantly extended; the occurrence is frequent. The gradient of refractivity is greater than -48 N-units/1000 feet and less than or equal to -24 N-units/1000 feet.

d. Trapping: Extreme superrefraction, with downward curvature equal to or greater than the curvature of the earth's surface. Radio/radar performance is greatly disturbed, ranges are greatly extended, holes in coverage may appear; occurrence is not normally frequent. The gradient of refractivity is less than or equal to -48 N-units/1000 feet.

5. For an understanding of refractive effects on the system being evaluated, refer to AFCS Pamphlet 100-79.

EQUIPMENT ANALYSIS SPECIFICATION LIST

A. Transmitters: AN/GRT-21 and AN/GRT-22 (TO 31R2-2GRT-102)

Percent of modulation, 0 dBm input:	:	90%±10%
Percent of modulation, -15 dBm input:	:	90%±10%
Percent of modulation, +10 dBm input:	:	90%±10%
Distortion:	:	10% at lower limiting
	:	15% at upper limiting
Frequency accuracy tolerance:	:	±0.0005% with freq synthesizer
Power output:	:	10 watts minimum, low power
	:	50 watts minimum, high power
Reflected power:	:	2.5 watts maximum, low power
	:	12.5 watts maximum, high power
Transmission system VSWR:	:	Normal operation at carrier power with VSWR not greater than 3 to 1
Coupler loss		
CU-547:	:	2 dB maximum (TO 31R1-2GR-142)
Antenna VSWR		
AS-1097/GR:	:	2:1 maximum (TO 31R1-2GR-241)
AT-197/GR:	:	1.6:1 maximum (TO 31R1-2GR-161)
AS-1181/UR:	:	2:1 maximum (TO 31R1-2UR-31)

B. Receivers: AN/GRR-23 and AN/GRR-24 (TO 31R2-2GRR-112)

Frequency accuracy tolerance:	:	±0.0005% with freq synthesizer
Sensitivity:	:	3uV maximum
Signal to noise:	:	10 dB with a 3uV input
Squelch threshold:	:	3uV (TO 31R2-2GRR-116WC-1)
AGC characteristics:	:	3 dB maximum variation with signal of 6uV to 1V
Audio output:	:	+20 dBm with older preamplifier module, +14 dBm with newer preamplifier module
Distortion:	:	for frequencies 300, 1500, and 3000 Hz with a 1V input: 10% maximum with 30% modulation, 20% maximum with 90% modulation
Transmission system VSWR:	:	no specification available
Coupler loss		
CU-547:	:	2 dB maximum (TO 31R1-2GR-142)
Antenna VSWR		
AS-1097/GR:	:	2:1 maximum (TO 31R1-2GR-241)
AT-197/GR:	:	1.6:1 maximum (TO 31R1-2GR-161)
AS-1181/UR:	:	2:1 maximum (TO 31R1-2UR-31)

EQUIPMENT ANALYSIS SPECIFICATION LIST

A. Transmitter: AN/GRT-18 (TO 31R2-2GRT18-2)

Percent of modulation, -10 dBm input:	:	90% minimum
Percent of modulation, -15 dBm input:	:	90% minimum
Percent of modulation, +6 dBm input:	:	90% minimum (50 watt mode only)
Percent of modulation, -9 dBm input:	:	90% minimum (50 watt mode only)
Distortion:	:	No specifications available
Frequency accuracy tolerance:	:	$\pm$0.0014% of the assigned freq
Power output:	:	10 watts minimum, low power mode
	:	50 watts minimum, high power mode
Reflected power:	:	1.1 watts maximum, 10 watt mode
	:	5.5 watts maximum, 50 watt mode
Antenna VSWR AS-1181/UR:	:	2:1 maximum (TO 31R1-2UR-31)

B. Receiver: AN/GRR-25 (TO 31R2-2GRR-25-2)

Frequency accuracy tolerance:	:	$\pm$0.002%
Sensitivity:	:	5 uV
Signal to noise:	:	10 dB with a 5 uV input
Squelch threshold:	:	3 uV maximum at maximum RF gain
AGC characteristics:	:	3 dB maximum variation with input signal of 15 uV to 1 V
Audio output:	:	+10 to +30 dBm main audio -10 to +10 dBm low level
Distortion:	:	15% maximum with a 1 V RF input signal modulated at 30%. 25% maximum with a 1 V RF signal modulated at 90%
Antenna VSWR AS-1181/UR:	:	2:1 maximum (TO 31R1-2UR-31)

EQUIPMENT ANALYSIS SPECIFICATION LIST

A. Transceiver: AN/GRC-171 (TO 31R2-2GRC171-2)

Percent of modulation, 0 dBm input:	:	90% ± 5%
Percent of modulation, -15 dBm input:	:	90% ∓ 5%
Percent of modulation, +10 dBm input:	:	90% ∓ 5%
Distortion:	:	10% maximum
Frequency accuracy tolerance:	:	±0.0005% both transmit and receive
Power output:	:	20 watts (16 - 24 average)
Transmission system VSWR:	:	1.3:1 or less is normal; 3:1 max
Sensitivity:	:	3 uV maximum
Signal to noise:	:	10 dB with a 3 uV input
Squelch threshold:	:	3 uV
AGC characteristics:	:	3 dB maximum variation with input signal of 6 uV to 1 V
Audio output:	:	+20 dBm
Distortion:	:	10% less with a 1 V RF input signal modulated at 30% (300, 1500, and 3000 Hz) and with an output of 20 dBm. 15% or less at 90% modulation.
Antenna VSWR		
AS-1097/GR:	:	2:1 maximum (TO 31R1-2GR-241)
AT-197/GR:	:	1.6:1 maximum (TO 31R1-2GR-161)

B. Transceiver: AN/GRC-175 (TO 31R2-2GR-1042)

Percent of modulation, 0 dBm input:	:	90%
Percent of modulation, +10 dBm input:	:	100%
Distortion:	:	No specification available
Frequency accuracy tolerance:	:	±0.001% both transmit and receive
Power output:	:	25 watts minimum
Transmission system VSWR:	:	1.3:1 or less is normal; 3:1 maximum
Sensitivity:	:	3 uV maximum
Signal to noise:	:	6 dB with a 3 hard uV input
Squelch threshold:	:	3 uV
AGC characteristics:	:	3 dB maximum variation with input signal of 5 uV to 100 mV
Audio output:	:	+20 dBm
Distortion:	:	7.5% or less with a 1 V RF input signal modulated at 30% (1000 Hz) and 20% or less at 90% modulation
Antenna VSWR		
AS-1181/UR:	:	2:1 maximum (TO 31R1-2UR-31)

TITLE:

EQUIPMENT ANALYSIS SPECIFICATION LIST

A. Communications Control Equipment: Four Channel Key System

1. Line, Speaker, Phone Amplifiers: AM-4571/G (TO 31R1-2G-102)

Gain:	-20 dBm input at 1 kHz, output should not be less than +30 dBm (or 50 dBm minimum gain
Noise level:	-40 dBm maximum
Distortion:	5% maximum at rated output (2 watts; +33 dBm)

2. Microphone Amplifiers: AM-4568/G (TO 31R1-2G-112)

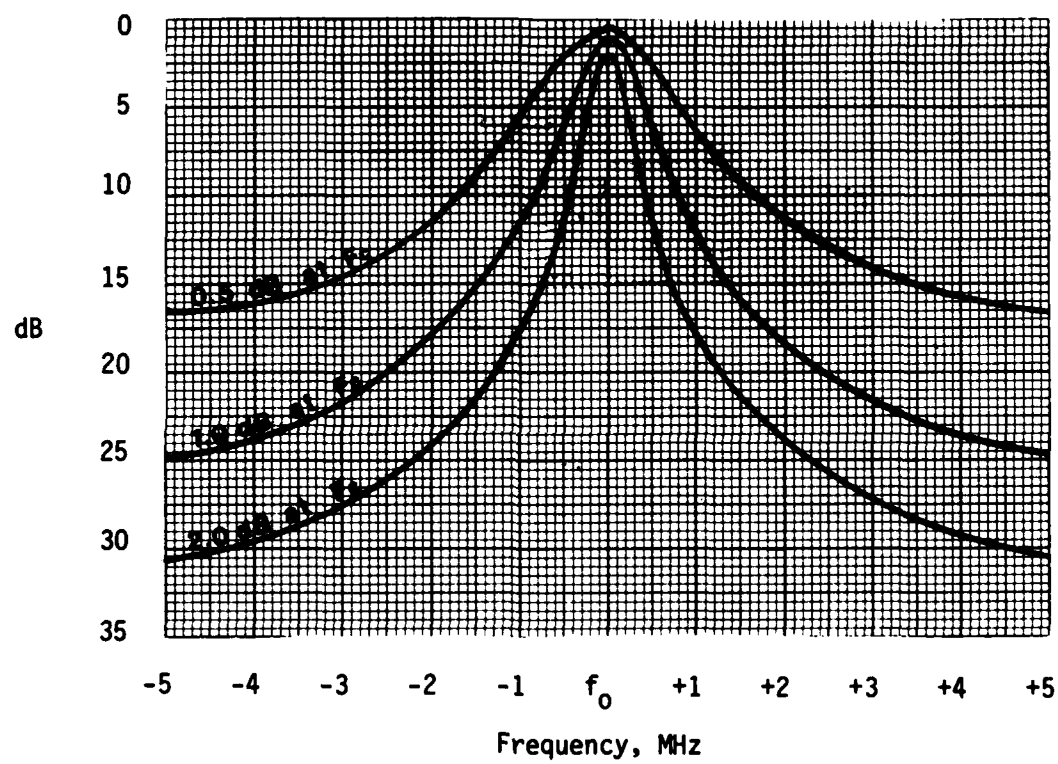
Gain:	-64 dBm input at 1 kHz, output should not be less than +8 dBm (or 72 dB minimum gain)
Noise level:	-40 dBm maximum
Distortion:	5% maximum at rated output (200 milliwatts; +23 dBm)

TITLE:

EQUIPMENT ANALYSIS SPECIFICATION LIST

A. Single Cavity RF Bandpass Filter: DB-4015-1*

1. Frequency Range: : 118-148 MHz
2. Insertion Loss (center frequency): : 0.5, 1.0, or 2.0 dB
3. Impedance: : 50 ohms
4. VSWR at Resonance: : 1.5:1
5. Attenuation:



* Extracted from manufacturer's specifications

A13-1 Attachment 13

AM RADIO COMMUNICATIONS EQUIPMENT ANALYSIS

DATE: March 1980

LOCATION: Keesler AFB

FREQUENCY MHz	320.1		121.8		121.5	
1. TRANSMITTER NOMENCLATURE	GRT-22		GRT-21		GRT-21	
2. SERIAL NUMBER	5572		392		9892	
	INITIAL	ADJUSTED	INITIAL	ADJUSTED	INITIAL	ADJUSTED
3. MODULATION LEVEL %	72**	90	51*	90	82	90
4. LOWER LIMITING %	54**	86	50*	84	82	88
5. UPPER LIMITING %	72**	90	51*	90	82	90
6. DISTORTION %	4.8	3.8	3.8	5.6	5.8	6.1
7. FREQUENCY ACCURACY %	.000034	.00003	.00003		.000025	
8. RF POWER OUT FORWARD Watts	7*	10	8*	10	8*	10
9. COUPLER VSWR	1.35		N/A		N/A	
10. COUPLER LOSS dB	1.4		N/A		N/A	
11. ANTENNA VSWR	1.22		1.49		1.49	
12. RECEIVER NOMENCLATURE	GRR-24		GRR-23		GRR-23	
13. SERIAL NUMBER	4795		24762		26434	
14. FREQUENCY ACCURACY %	.00007		.000016		.00007	
15. SENSITIVITY UV	2.0		1.7		1.5	
16. SIGNAL TO NOISE dB	14.0		15.5		16.4	
17. SQUELCH THRESHOLD UV	3.8*	3.0	3.0		3.0	
18. AGC	0.3		1.2		0.3	
19. AUDIO OUT dBm Equip / Line	0.0* / 0.0	20.0 / 0.0	-1.0* / -1.0*	15.5 / 0.0	15.0 / 15.0*	/ 0.0
20. DISTORTION %	1.8		3.2		4.0	
21. COUPLER VSWR	1.35:1		N/A		N/A	
22. COUPLER LOSS dB	1.4		N/A		N/A	
23. ANTENNA VSWR	1.22:1		1.49:1		1.49:1	

REMARKS
* Out of tolerance
** Referred to maintenance

AFCS FORM OCT 78 957 PREVIOUS EDITION IS OBSOLETE

Attachment 13

AM RADIO COMMUNICATIONS EQUIPMENT ANALYSIS

DATE: March 1980

LOCATION: Keesler AFB

FREQUENCY	MHz	275.8		126.2			
1. TRANSMITTER NOMENCLATURE		GRT-22		GRT-21			
2. SERIAL NUMBER		5431		2513			
		INITIAL	ADJUSTED	INITIAL	ADJUSTED	INITIAL	ADJUSTED
3. MODULATION LEVEL	%	93	86	63* *			
4. LOWER LIMITING	%	92	86	60* *			
5. UPPER LIMITING	%	90	86	64* *			
6. DISTORTION	%	6.0	5.8	7.0			
7. FREQUENCY ACCURACY		.000037		.00005			
8. RF POWER OUT FORWARD	Watts	8*	10	7*	**		
9. COUPLER VSWR		1.02		N/A			
10. COUPLER LOSS	dB	1.2		N/A			
11. ANTENNA VSWR		1.67		1.28			
12. RECEIVER NOMENCLATURE		GRR-24		GRR-23			
13. SERIAL NUMBER		4488		9296			
14. FREQUENCY ACCURACY	%	.00001		.00001			
15. SENSITIVITY	UV	14*		5.2*			
16. SIGNAL TO NOISE	dB	2.5*		5.0*			
17. SQUELCH THRESHOLD	UV	3.6*	3.0	3.0			
18. AGC		0.2		0.8			
19. AUDIO OUT	Equip / Line dBm	12.0 * / 0.5	21.5 / 0.0	15.0* / -1.0	20.5 / 0.0		
20. DISTORTION	%	2.8		4.2			
21. COUPLER VSWR		1.02 :1		N/A			
22. COUPLER LOSS	dB	1.2		N/A			
23. ANTENNA VSWR		1.67 :1		1.28 :1			

REMARKS: *Out of tolerance
** Referred to Maintenance

TITLE: AM RADIO COMMUNICATIONS EQUIPMENT ANALYSIS

LOCATION	DATE
Keesler AFB (Control Tower)	March 1980

TRANSCEIVER NOMENCLATURE	AN/GRC-171					
SERIAL NUMBER	1336					
FREQUENCY	375.8		320.1		250 0	
	INITIAL	ADJUSTED	INITIAL	ADJUSTED	INITIAL	ADJUSTED
MODULATION LEVEL %	93		95		93	
UPPER LIMITING %	93		95		92	
LOWER LIMITING %	93		95		93	
DISTORTION %	4.8		8.8		6.0	
FREQUENCY ACCURACY %	0.0001		0.0001		0.0001	
RF POWER OUT FORWARD Watts	18		19.5		20.5	**
SENSITIVITY UV	3.5*		4.0*		3.3*	
SIGNAL TO NOISE dB	8.0*		7.0*		7.5*	
SQUELCH THRESHOLD UV	3.0		3.0		1.6*	3.0
AGC	1.2		1.2		1.2	
AUDIO OUT Line dBm	20.5		20.5		18.0 *	20.5
DISTORTION %	3.5		3.8		3.9	
ANTENNA VSWR	1.28:1		1.08:1		1.28:1	

REMARKS

* Out of tolerance

** Power out was initially 1.5 watts. Discovered bad front panel connecting link from transceiver to antenna.

TITLE

AM RADIO COMMUNICATIONS EQUIPMENT ANALYSIS

LOCATION Keesler AFB (Control Tower)

DATE March 1980

TRANSCEIVER NOMENCLATURE	AN/GRC-175					
SERIAL NUMBER	524					
FREQUENCY	116.0		125.0		135.0	
	INITIAL	ADJUSTED	INITIAL	ADJUSTED	INITIAL	ADJUSTED
MODULATION LEVEL %	51*		48*		49*	
UPPER LIMITING %	N/A		N/A		N/A	
LOWER LIMITING %	55*		52*		52*	
DISTORTION %	N/A		N/A		N/A	
FREQUENCY ACCURACY %	0.00007		0.00015		0.00007	
RF POWER OUT FORWARD Watts	50		38		33	
SENSITIVITY UV	3.2*		2.0		2.7	
SIGNAL TO NOISE dB	5.5*		9.5		7.5	
SQUELCH THRESHOLD UV	4*		4*		4*	
AGC	0		.4		.4	
AUDIO OUT Line dBm	-.5		-.5		-.5	
DISTORTION %	7.9		8		9.5	
ANTENNA VSWR	1.78:1		1.67:1		1.23:1	

REMARKS * Out of tolerance

AFCS FORM MAY 71 906 GENERAL INFORMATION

AM RADIO COMMUNICATIONS EQUIPMENT ANALYSIS

DATE March 1980

LOCATION Keesler AFB (Control Tower)

FREQUENCY MHz	126.2		320.1			
1. TRANSMITTER NOMENCLATURE	GRT-21		GRT-22			
2. SERIAL NUMBER	3884		8393			
	INITIAL	ADJUSTED	INITIAL	ADJUSTED	INITIAL	ADJUSTED
3. MODULATION LEVEL %	70*	90	78*	**		
4. LOWER LIMITING %	70*	90	74*			
5. UPPER LIMITING %	70*	90	78*			
6. DISTORTION %	19.5*	4.4	12.5 *	**		
7. FREQUENCY ACCURACY %	0.00061*	**	0.00003			
8. RF POWER OUT FORWARD Watts	9.5*	10.0	10			
9. COUPLER VSWR	N/A		N/A			
10. COUPLER LOSS dB	N/A		N/A			
11. ANTENNA VSWR	2.61:1*	**	1.20:1			
12. RECEIVER NOMENCLATURE	AN/GRR-25		AN/GRR-24			
13. SERIAL NUMBER	66-407		3026			
14. FREQUENCY ACCURACY %	NM		0.00009			
15. SENSITIVITY UV	1.2		1.0			
16. SIGNAL TO NOISE dB	16.5		18			
17. SQUELCH THRESHOLD UV	27 mw *	**	1.1*	3.0		
18. AGC	1.2		.8			
19. AUDIO OUT Line / Equip dBm	1.2 * / 8		-1.8 * / 13*	0 / 20.6		
20. DISTORTION %	5.9		2.1			
21. COUPLER VSWR	N/A		N/A			
22. COUPLER LOSS dB	N/A		N/A			
23. ANTENNA VSWR	2.10:1*	**	1.17:1			

REMARKS * Out of tolerance ** Turned over to Maintenance
NM = Not Measured

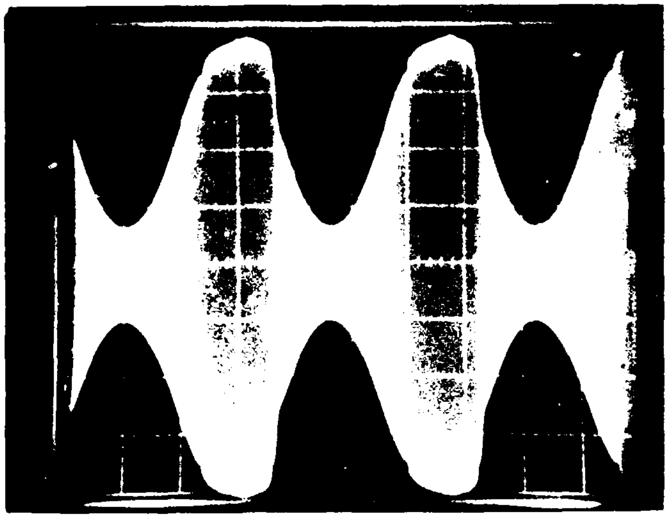
AFCS FORM OCT 78 957 PREVIOUS EDITION IS OBSOLETE

TITLE:

TRANSMITTER MODULATION ENVELOPE DISTORTION

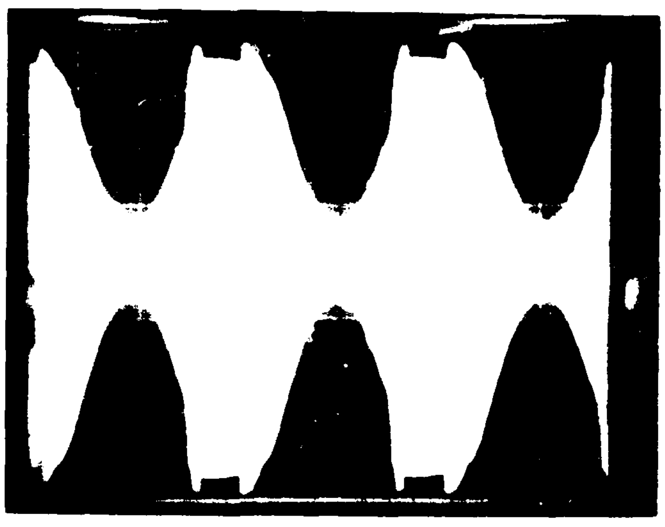
LOCATION	DATE
Keesler AFB	March 1980

Photo #1



Frequency:	320.1 MHz
Transmitter:	AN/GRT-22
Serial Number:	5572

Photo #2



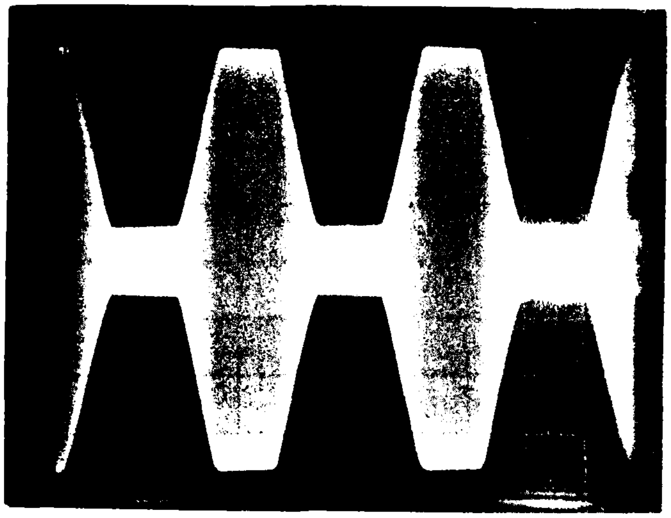
Frequency:	320.1 MHz (Tower Backup)
Transmitter:	AN/GRT-22
Serial Number:	8393

TITLE:

TRANSMITTER MODULATION ENVELOPE DISTORTION

LOCATION	DATE
Keesler AFB	March 1980

Photo #3



Frequency: 126.2 MHz (Tower Backup)
Transmitter: AN/GRT-21
Serial Number: 3884

Photo #4

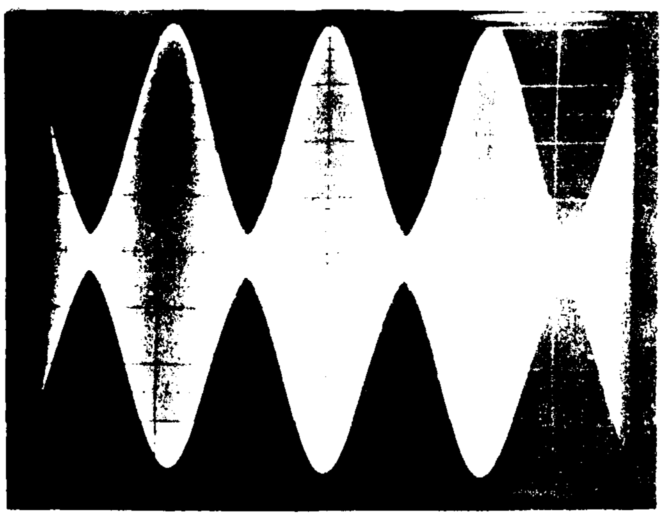


Photo of an AN/GRT-22 transmitter with proper modulation envelope showing low distortion.

TITLE:

VHF Interference Study

LOCATION: Keesler AFB (GATR Site)

DATE: March 1980

TABLE #1

Signal Strength Of Off-Channel Interference

Test Number	Transmitter Frequency	Transmitter Power	Receiver Antenna #	Receiver Frequency	Off-Channel Signal Strength
1	121.8 MHz	+40dBm (10W)	E/3	121.5 MHz	+2dBm (1.6 mW)
2	121.8 MHz	+40dBm (10W)	C/1	126.2 MHz	+19dBm (80 mW)
3	126.2 MHz	+40dBm (10W)	A/6	121.8 MHz	+20dBm (100 mW)
4	126.2 MHz	+40dBm (10W)	E/3	121.5 MHz	-26dBm (.0025 mW)

TABLE #2

Squelch Threshold Level To Block Out Off-Channel Interference*

Test Number	121.8 MHz	121.5 MHz	126.2 MHz
1	-83 dBm (16uV)	-94 dBm (4.5uV)	-81 dBm (20uV)

REMARKS

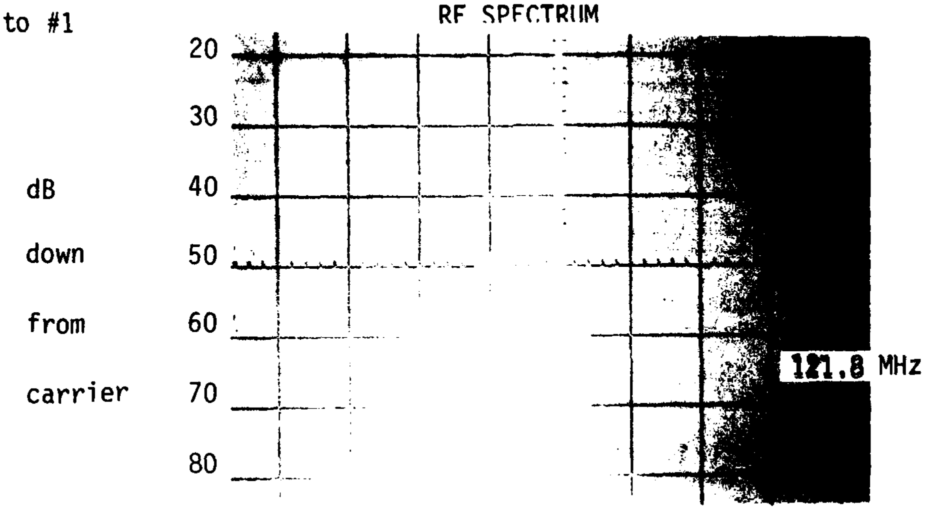
*Listed level is with antennas swapped around to achieve a squelch threshold level as close to -97.5dBm (3uv) as possible.

TITLE:

VHF Interference Study

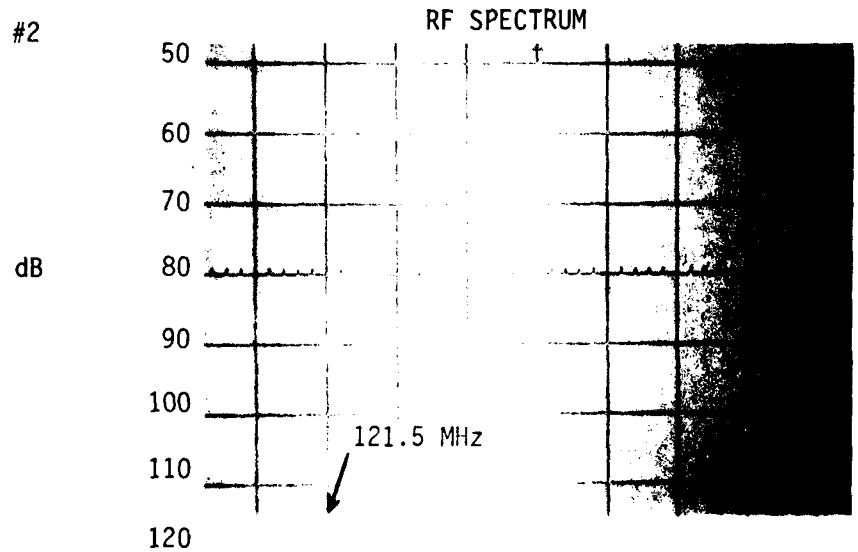
LOCATION		DATE
Keesler AFB	(GATR Site)	March 1980

Photo #1



Center Frequency: 121.5 MHz
Scan Width: 100 kHz per division
Vertical Calibration: 10 dB per division
Input Attenuation: 10 dB

Photo #2



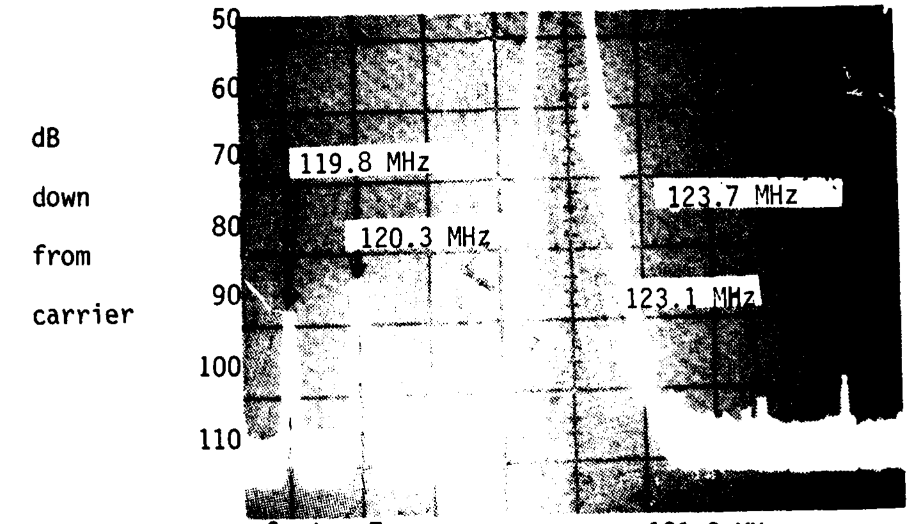
Center Frequency: 121.8 MHz
Scan Width: 100 kHz per division
Vertical Calibration: 10 dB per division
Input Attenuation: 50 dB
Log Reference Level: 10 dB

TITLE:

VHF Interference Study

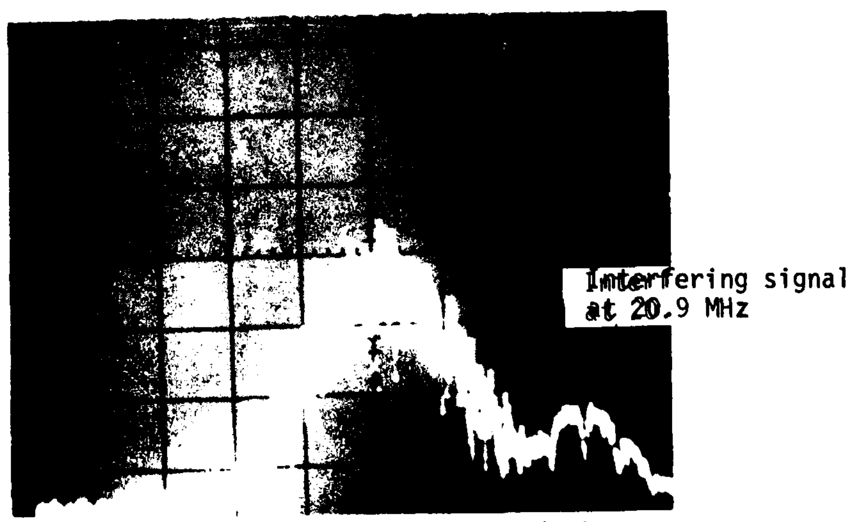
LOCATION		DATE
Keesler AFB	(GATR Site)	March 1980

Photo #3 RF SPECTRUM WITH SPURIOUS EMISSIONS BY FREQUENCY



Center Frequency:	121.8 MHz
Scan Width:	.5 MHz per division
Input Attenuation:	20 dB
Log Reference Level:	-10 dB

Photo #4 IF OUTPUT WITH UNWANTED SIGNAL



Center Frequency:	20.6 MHz (IF)
Receiver:	AN/GRR-23 (121.8 MHz)
Input:	+10 dBm at 121.5MHz from RF Signal Generator (90% modulation)
Note:	Receiver Squelch is broken

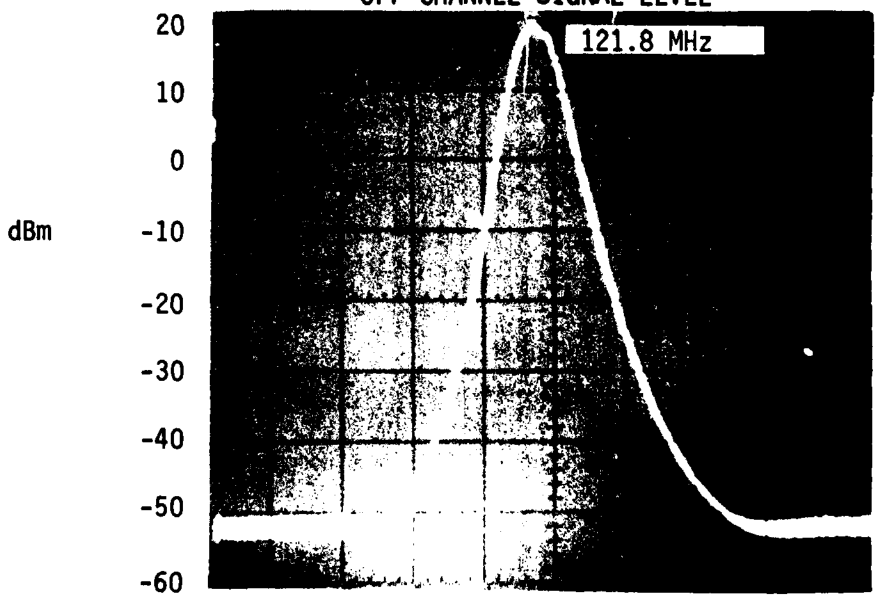
TITLE:

VHF Interference Study

LOCATION		DATE
Keesler AFB	(GATR Site)	March 1980

Photo #5

OFF-CHANNEL SIGNAL LEVEL



Frequency:	121.8 MHz
Signal Input:	126.2 MHz Receiver Antenna Jack
Transmitter Power:	10 Watts (+40 dBm)
Received Carrier Level:	+19 dBm
Scan Width:	.5 MHz per division

TITLE

ANTENNA VSWR AND COUPLER VSWR-LOSS DATA

LOCATION: Keesler AFB (GATR Site) DATE: March 1980

ANTENNA SYSTEM					COUPLER				
No.	TYPE	VSWR	COUPLER SERIAL #	FREQ (MHz)	PORT	LOSS (dB) INIT	LOSS (dB) ADJ	VSWR INIT	VSWR ADJ
A/6	AS-1181	1.49:1		121.8					
B/8	AS-1097	1.49:1	1773	236.6	1	1.6		1.50:1	
		1.22:1		320.1	2	1.4		1.35:1	
		1.07:1		271.8	3	1.5		1.10:1	
		1.32:1		349.4	4	1.4		1.44:1	
C/1	AS-1181	1.28:1		126.2					
D/7	AS-1097	1.49:1	20	372.2	1	1.3		1.02:1	
		1.17:1		344.6	2	1.2		1.00:1	
		1.49:1		243.0	3	1.2		1.02:1	
		1.67:1		275.8	4	1.2		1.03:1	
E/3	AS-1181	1.49:1		121.5					
G/5	AS-1097	2.32:1*		SPARE					
I/4	AS-1097	**		SPARE					
K/2	AT-197	1.32:1		SPARE					

REMARKS

* Out of tolerance

** This antenna is useable between 240 and 370 MHz; above or below this range the VSWR is above acceptable limits.

TITLE

ANTENNA VSWR AND COUPLER VSWR-LOSS DATA

LOCATION	DATE
Keesler AFB (Control Tower)	March 80

ANTENNA SYSTEM

No.	TYPE	VSWR	COUPLER SERIAL #	FREQ (MHz)
A	AT-197	1.32:1		GRC-171
B	AS-1181	1.67:1		GRC-175
C	AS-1181	2.61:1*		126.2
E	AT-197	1.20:1		320.1

COUPLER

PORT	LOSS (dB) INIT	LOSS (dB) ADJ	VSWR INIT	VSWR ADJ

REMARKS * Out of tolerance

TITLE

AMPLIFIER DATA

LOCATION		DATE
Keesler AFB	(Control Tower)	March 1980

Audio Frequency Amplifier AM-4568/G
· (Microphone Amplifier)

MEASUREMENTS									
		Serial Number		181	666	919	383		
		Position		MAINT	POS 1	POS 2	POS 3		
	SYSTEM	Input Level	dBm	-35	-35	-35	-35		
		Output Level	dBm	19.6	17.5	20.6	21.4		
		Distortion	%	3.0	3.4	2.0	2.25		
		Noise Level	dBm	-41	-61.5	-73	-75.5		
		Input at Limiting	dBm	-39	-39	-39	-39		
		Output at Limiting	dBm	19.5	20.6	20.4	21.1		
	GAIN	Input Level	dBm	-64	-64	-64	-64		
		Output Level	dBm	22.2	27.7	21.5	22.7		
		Distortion	%	3.0	2.3	1.95	2.35		
		Noise Level	dBm	-4 *	-12.8 *	-3.8*	-9.5 *		

*Out of tolerance

REMARKS

TITLE

AMPLIFIER DATA

LOCATION		DATE
Keesler AFB	(Control Tower)	March 1980

Audio Frequency Amplifier AM-4571/G
(Line)

				320.1	243.0	275.8	126.2	121.8	121.5
MEASUREMENTS	SYSTEM	Input Level	dBm	-1.1	-0.8	-1.1	-1.2	-1.3	-1.2
		Output Level	dBm	26	26	26	26	26	26
		Distortion	%	3.7	4.7	4.7	5.3*	22*	4.0
		Noise Level	dBm	-41.5	-53.5	-57	-58	-58	-45.5
		Noise Floor	dBm	28.6	26.5	26.7	25.6	-13	25.8
	GAIN	Input Level	dBm	-20	-20	-20	-20	-20	-20
		Output Level	dBm	35.4	35.2	34.5	35	33.7	35.5
		Distortion	%	4.8	4.9	5.1*	5.3*	25.8*	4.6
		Noise Level	dBm	-35.5*	-39.2*	-38 *	-41.8	-42.5	-39 *

Audio Frequency Amplifier AM-4571/G
(Line)

				121.8 SPARE					
MEASUREMENTS	SYSTEM	Input Level	dBm	-1.3					
		Output Level	dBm	26					
		Distortion	%	4.8					
		Noise Level	dBm	-58					
		Noise Floor	dB	26.5					
	GAIN	Input Level	dBm	-20					
		Output Level	dBm	34.3					
		Distortion	%	4.9					
		Noise Level	dBm	-44.5					

REMARKS

* Out of tolerance

TITLE

AMPLIFIER DATA

LOCATION		DATE
Keesler AFB	(Control Tower)	March 1980

Audio Frequency Amplifier AM-4571/G
(Speaker and Phone)

				POS 3 Speaker	POS 3 Phone	POS 2 Speaker 1	POS 2 Speaker2	POS 2 Speaker3	POS 2 Phone
MEASUREMENTS	SYSTEM	Input Level	dBm	**	**	**	**	**	**
		Output Level	dBm	0	-15	0	0	0	-15
		Distortion	%	1.1	3.2	1.7	1.3	10.8*	4.5
		Noise Level	dBm	-59.2	-55	-52.5	-45	-61.5	-60.2
	GAIN	Input Level	dBm	-20	-20	-20	-20	-20	-20
		Output Level	dBm	35.7	35.5	35.4	35.4	35.4	35.5
		Distortion	%	4.5	5.4*	5.2*	5.7*	6.5*	5.5*
		Noise Level	dBm	-52.6	-50.6	-46	-51.5	-51.8	-52.5

Audio Frequency Amplifier AM-4571/G

MEASUREMENTS	SYSTEM	Input Level	dBm						
		Output Level	dBm						
		Distortion	%						
		Noise Level	dBm						
	GAIN	Input Level	dBm						
		Output Level	dBm						
		Distortion	%						
		Noise Level	dBm						

REMARKS

* Out of tolerance
** Unable to measure

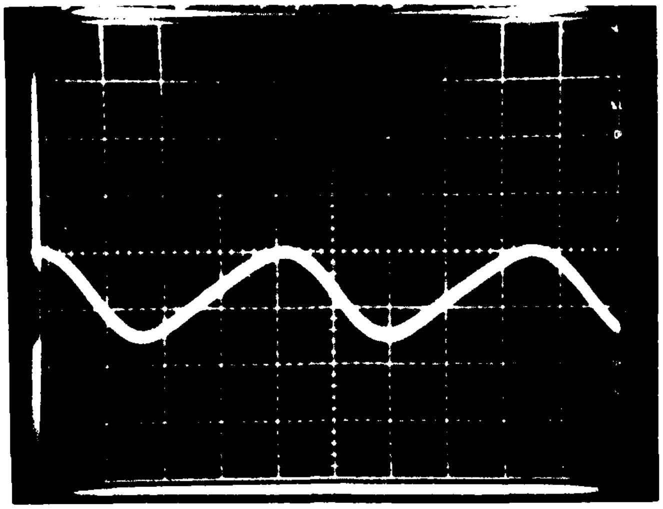
TITLE:

AMPLIFIER DATA

LOCATION	DATE
Keesler AFB (Control Tower)	March 1980

Photo #1

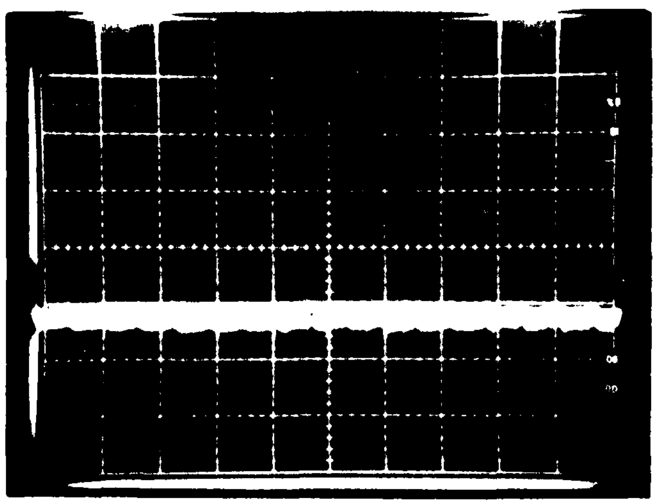
OUTPUT VOLTAGE RIPPLE (OUT OF TOLERANCE)



Line Amplifier Power Supply # 2567
Vertical: .1 volt per division
Horizontal: .5 usec per division
Frequency (Approx.): 445 kHz

NORMAL RIPPLE VOLTAGE

Photo #2



Line Amplifier Power Supply # 2518
Vertical: 20 mv per division
Horizontal: 5 msec per division
Frequency (Approx.): 300 Hz

AM RADIO COMMUNICATIONS SYSTEM LOOP ANALYSIS

Keesler AFB — March 1980

TRANSMIT SIDE

Frequency MHz	320.1	243.0	275.8	126.2	121.8	121.5	
Control Tower							
Mic Amp In dBm	-35	-35	-35	-35	-35	-35	
Mic Amp Out dBm	19.6	19.6	19.6	19.6	19.6	19.6	
Cable Out dBm	0	0	0	-1 **	0	0	
Noise Floor dB down	32.5	34	33.7	22.7	32.4	33.4	
Noise Level dBm	-39*	-38.6 *	-38.5 *	-34.2 *	-42.4	-39.8 *	
GATR Site							
Cable In dBm	-1.2	-1.2	-1.2	-7.9 *	-1.5	-1.5	
Noise Floor dB down	40.5	41.5	41	34.5	41	41	
Noise Level dBm	-59	-59	-59.5	-30 *	-57	-68	

RECEIVE SIDE

GATR Site							
Cable Out dBm	0	0	0	0	0	0	
Noise Floor dB down	30	21	24	23.5	25	22	
Noise Level dBm	-41	-64	-40	-47	-54	-45.5	
Control Tower							
Cable In dBm	-1.1	-0.8	-1.1	-1.2	-1.3	-1.2	
Noise Floor dB down	30.7	22.3	26	24.9	28	34.8	
Noise Level dBm	-37.8 *	-39.6 *	-30 *	-39.2 *	-37.5 *	-34.4 *	
Line Amp In dBm	-1.1	-0.8	-1.1	-1.2	-1.3	-1.2	
Line Amp Out dBm	26	26	26	26	26	26	
Noise Floor dB down	26.3	26.5	23.6	21.5	13	23.2	
Noise Level dBm	-35.5 *	-39.2 *	-38 *	-41.8	-42.5	-39 *	

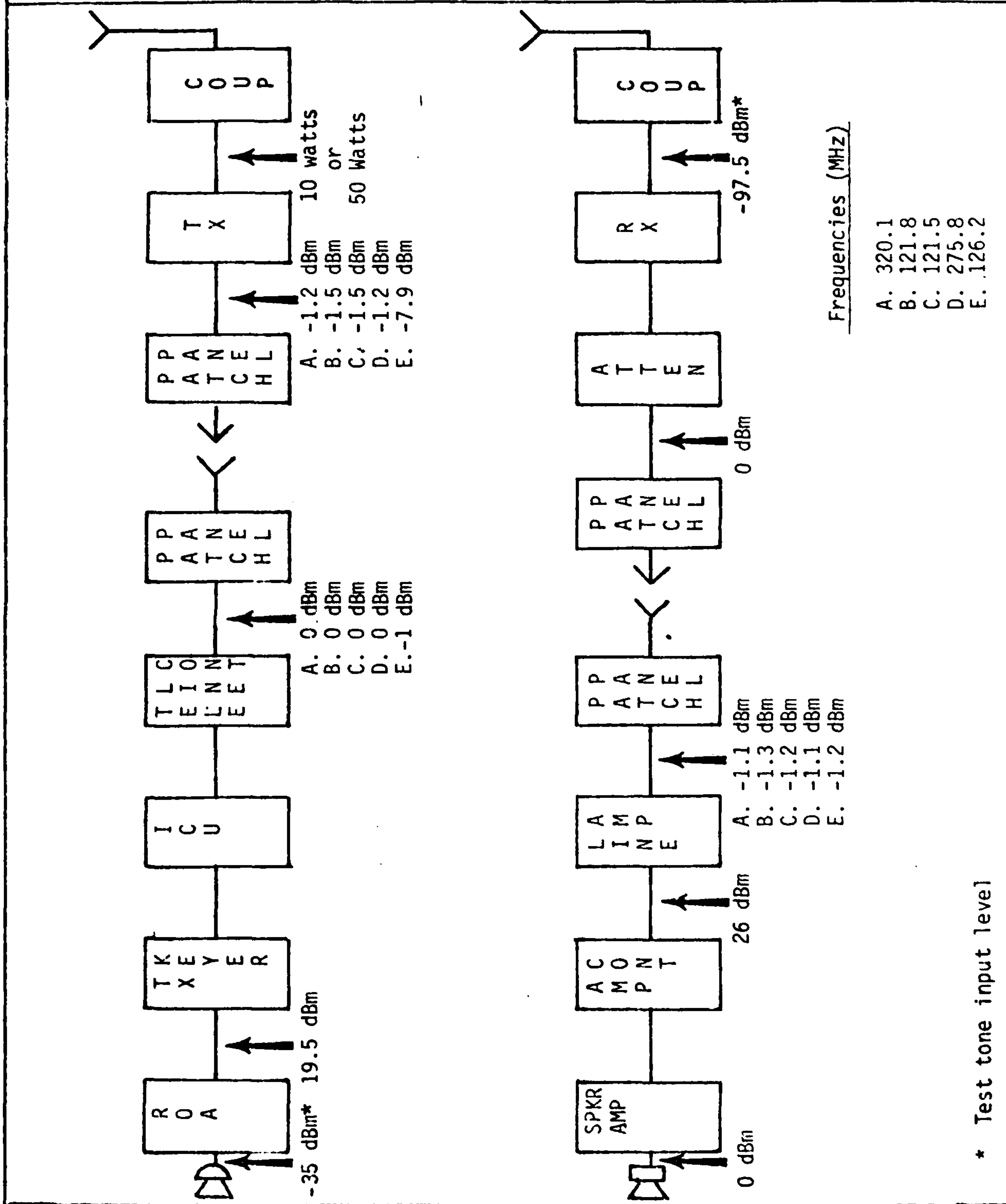
* Out of tolerance ** Interlock Control Unit adjusted to maximum

TITLE

LOOP TEST LINE LEVEL DIAGRAM

LOCATION: Keesler AFB

DATE: March 1980



REMARKS

A. C. POWER	DATE March 1980
LOCATION Keesler AFB	EQUIPMENT & SERIAL NUMBER GATR Site

CHECK	SPECIFICATIONS	PRIME POWER			STANDBY POWER		
1. VISUAL INSPECTION		SAT			SAT		
2. REGULATOR INPUT		VOLTAGE INITIAL	VOLTAGE ADJUSTED	CURRENT	VOLTAGE INITIAL	VOLTAGE ADJUSTED	CURRENT
PHASE A		130		26	125		21
PHASE B		130		32	125		30
PHASE C		130		14	125		20
A + B							
NEUTRAL				8			10
3. POWER FACTOR							

GENERATOR	MANUFACTURER Pincor Alternator	TYPE RFWD30SBA3	SERIAL NUMBER 1011
	CAPACITY 25 KW	FREQUENCY 60	LOAD
AUTOMATIC CHANGEOVER	MANUFACTURER Pincor	TYPE ATP200.3BFGCCEEIN	CHANGEOVER INTERVAL 7 seconds

VOLTAGE REGULATOR RESPONSE

VOLTAGE REGULATOR	SPECIFICATION	AS FOUND	ADJUSTED TO: MANUALLY	ADJUSTED TO: AUTOMATIC	TIME TO ADJUST
PHASE A					
PHASE B					
PHASE C					

EQUIPMENT GROUNDING

REMARKS

☆ U S GOVERNMENT PRINTING OFFICE 1978 665-009 617

A. C. POWER									DATE March 1980

LOCATION	EQUIPMENT & SERIAL NUMBER
Keesler AFB	Control Tower

CHECK	SPECIFICATIONS	PRIME POWER			STANDBY POWER		
1. VISUAL INSPECTION		SAT			SAT		
2. REGULATOR INPUT		VOLTAGE INITIAL	VOLTAGE ADJUSTED	CURRENT	VOLTAGE INITIAL	VOLTAGE ADJUSTED	CURRENT
PHASE A		120		40	120		80
PHASE B		120		23	120		36
PHASE C		120		23	120		62
A + B							
NEUTRAL				17			17
3. POWER FACTOR							

GENERATOR	MANUFACTURER Caterpillar	TYPE MOD2E3406PC	SERIAL NUMBER 90U5007
	CAPACITY 250 KW	FREQUENCY 60	LOAD
AUTOMATIC CHANGEOVER	MANUFACTURER ASCO	TYPE 940	CHANGEOVER INTERVAL 5 seconds

VOLTAGE REGULATOR RESPONSE

VOLTAGE REGULATOR	SPECIFICATION	AS FOUND	ADJUSTED TO: MANUALLY	ADJUSTED TO: AUTOMATIC	TIME TO ADJUST
PHASE A					
PHASE B					
PHASE C					

EQUIPMENT GROUNDING

REMARKS

* U S GOVERNMENT PRINTING OFFICE 1978—665-009/617

TITLE

RSL MEASUREMENT FLIGHT PROFILE

LOCATION

Keesler AFB

DATE

March 1980

Track	Track Description*	Flight Altitude (ft MSL)	Freq(MHz)/ Antenna #	Power (Watts)	Date Flown
1	R-032 Out	3000	320.1/TX-8	10.0	14 Mar
2	R-032 In	2000	320.1/TX-8	10.0	14 Mar
3	30 NM Orbit	2500	320.1/TX-8	10.0	14 Mar
4	R-260 Out	3000	320.1/TX-8	10.0	14 Mar
5	R-260 In	2000	320.1/TX-8	10.0	14 Mar
6	R-080 Out	3000	320.1/TX-8	10.0	14 Mar
7	R-080 In	2000	320.1/TX-8	10.0	14 Mar
8	R-190 Out	3000	320.1/TX-8	10.0	14 Mar
9	R-190 In	2000	320.1/TX-8	10.0	14 Mar
10**	15 NM Orbit	1900	320.1/Tower-1	10.0	14 Mar

*R = Radial
**Control Tower Backup

REMARKS

FLIGHT INSPECTION REPORT — COMMUNICATIONS

Reports Identification Symbol FS 8071-23

1. STATION (Controller location)	2. EQUIPMENT LOCATION	3. LOCATION IDENT.	4. REPORTING PERIOD
Keesler AFB, MS	Keesler AFB, MS		14 March 1980

5. TYPE OF INSPECTION

	SITE EVALUATION		PERIODIC	X	SPECIAL
	COMMISSIONING		SURVEILLANCE		INCOMPLETE

6. COMMON SYSTEM

	YES
	NO

7. OWNER

	FAA		U S ARMY	PRIVATE (Indicate actual owner)
			U S NAVY	
	INTER-NATIONAL	X	U S A F	OTHER (Indicate actual owner)
			U S C G	

8. SERVICE INSPECTED		APPROACH CONTROL		STATION	X	TOWER		CENTER

9. FREQUENCIES PERFORMANCE

FREQUENCIES USED	PRIMARY		SECONDARY		VOICE QUALITY		COVERAGE		STANDBY POWER	
	SAT.	UNSAT.	SAT.	UNSAT	SAT.	UNSAT.	DIST.	ALT.	SAT.	UNSAT
121.5 VHF Guard	X				X					
121.8 Ground Control	X				X					
126.2 VHF Primary	X		X		*					
243.0 UHF Guard	X				X					
271.8 ATIS	X				X		50NM	180		
275.8 Ground Control	X				X					
320.1 Primary	X		X		X					
344.6 PMSV**		X				X	30NM	120		
372.2 PTD	X				X					

10. LIGHT GUN	X	SATISFACTORY	11. OPERATOR PERFORMANCE	X	SATISFACTORY
		UNSATISFACTORY			UNSATISFACTORY

12. DISCREPANCIES AND/OR REMARKS — CORRECTED: YES / NO

Keesler AFB does not have a GCA or RAPCON.

* Useable but has some distortion.

** Distorted- workorder was open on this transmitter.

FACILITY CLASSIFICATION		FLIGHT INSPECTOR'S SIGNATURE	REGION
X	UNRESTRICTED		
	RESTRICTED		FIELD OFFICE
	UNUSEABLE		1866 FCS

TITLE:

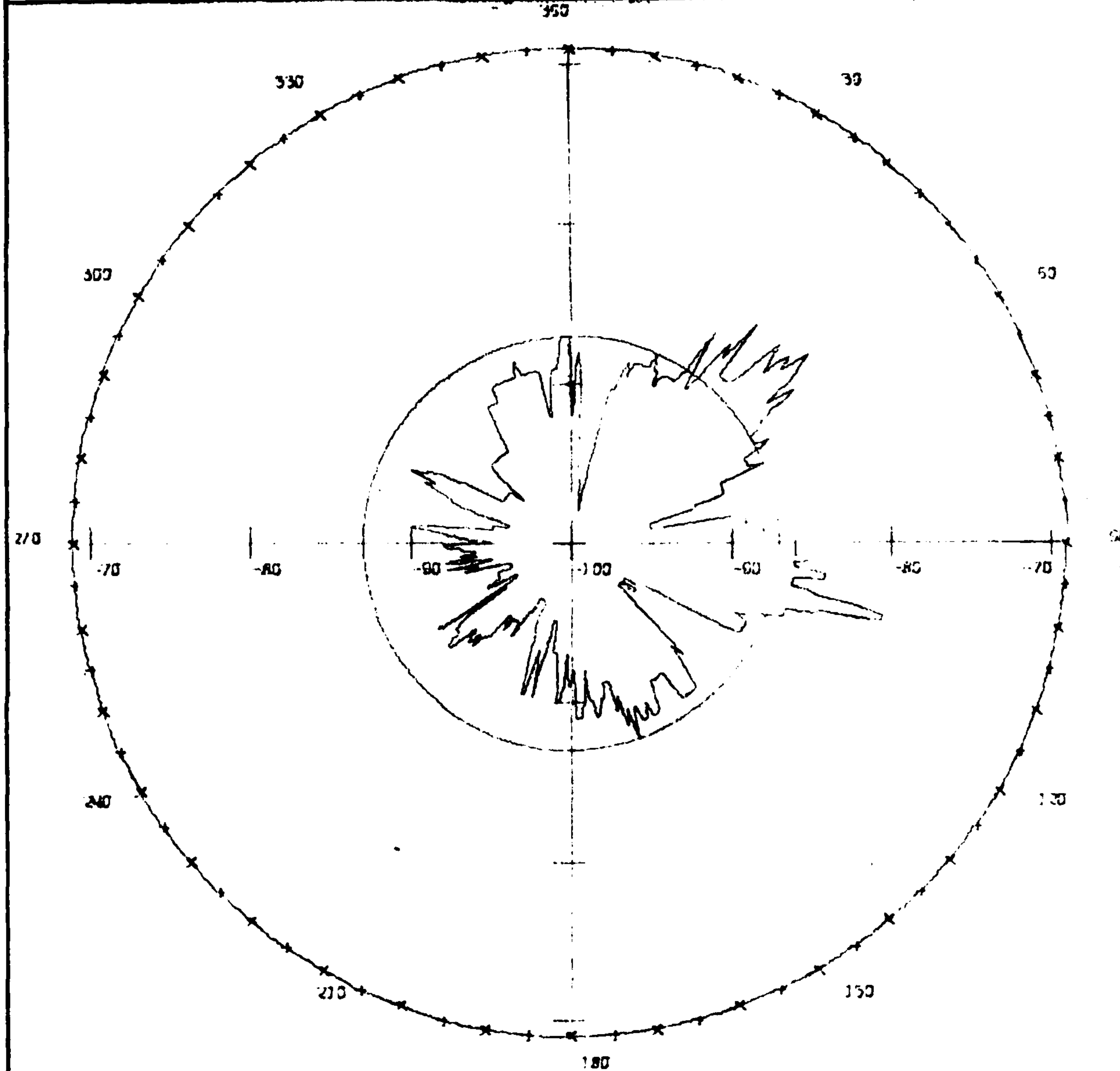
Measured Signal Strength

LOCATION

Keesler AFB (GATR Site)

DATE

March 1980



KEESLER AFB
TRANSMITTER SITE TRACK 3
AN/GRT-22

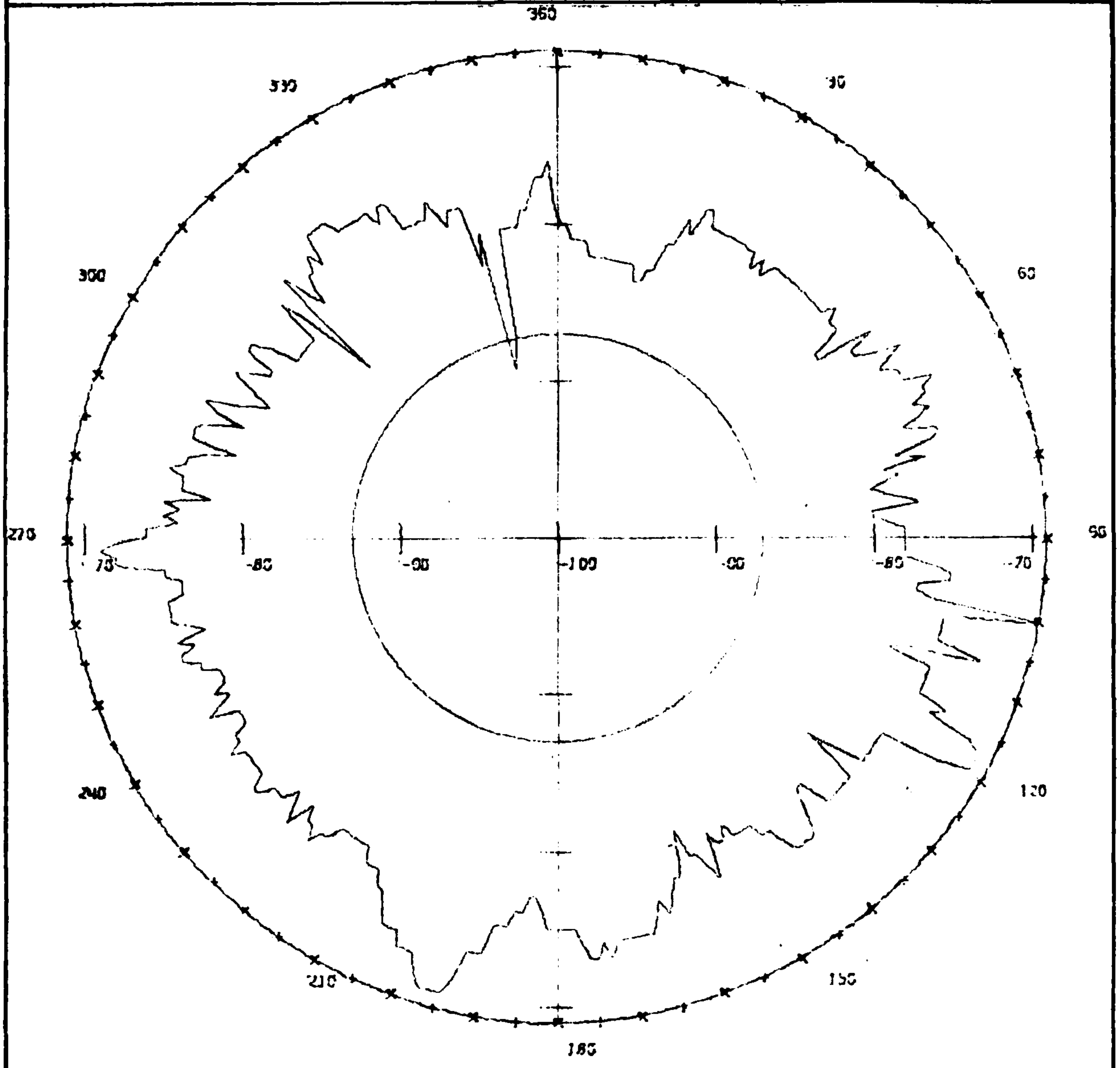
RANGE 30 NM.
ALTITUDE 2500 FT. MSL
FREQUENCY 320.10 MHZ

VARIATION 4 DEGREES EAST
SCALE 1 INCH = 10 DB
ORIENTED TO MAGNETIC NORTH
-87 DBM = 10 UVOLTS
14 MAR 80

TITLE:

MEASURED SIGNAL STRENGTH

LOCATION		DATE
Keesler AFB	(Control Tower)	March 1980



KEESLER AFB
CONTROL TOWER TRACK 10
AN/GRT-22

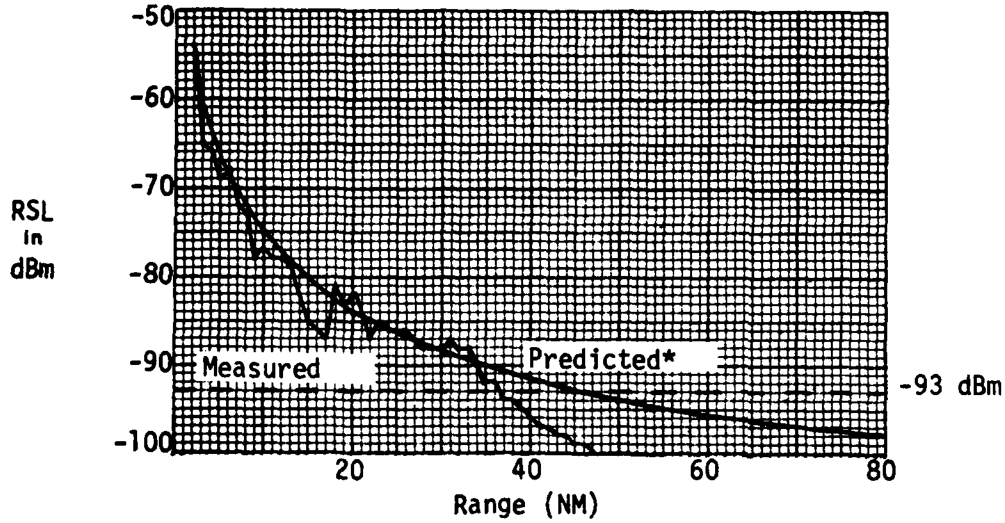
RANGE 15 NM.
ALTITUDE 1900 FT. MSL
FREQUENCY 320.10 MHZ

VARIATION 4 DEGREES EAST
SCALE 1 INCH = 10 DB
ORIENTED TO MAGNETIC NORTH
-87 DBM = 10 UVOLTS
14 MAR 80

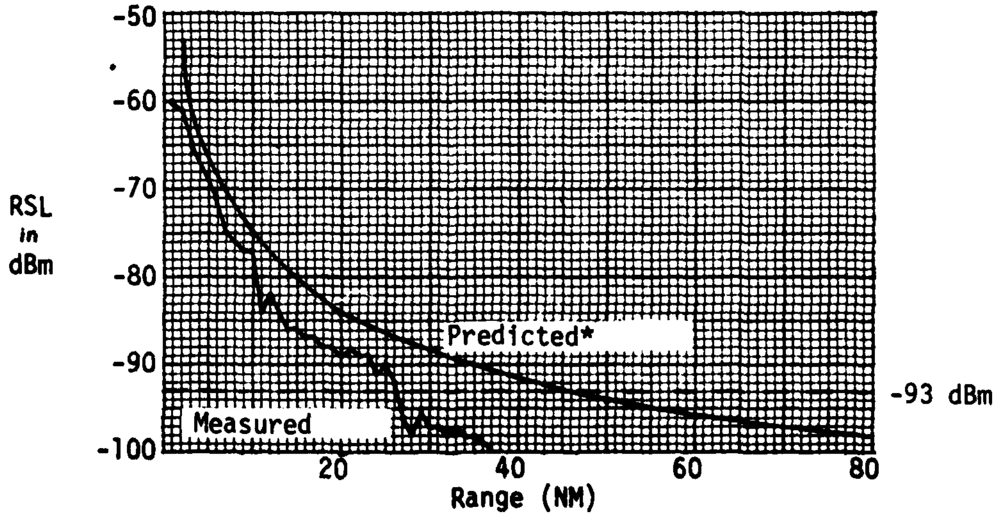
TITLE:

CORRELATION OF PREDICTED AND MEASURED RSL

LOCATION	DATE
Keesler AFB	March 1980



Track # 2
Radial 032
Altitude 2000 feet MSL



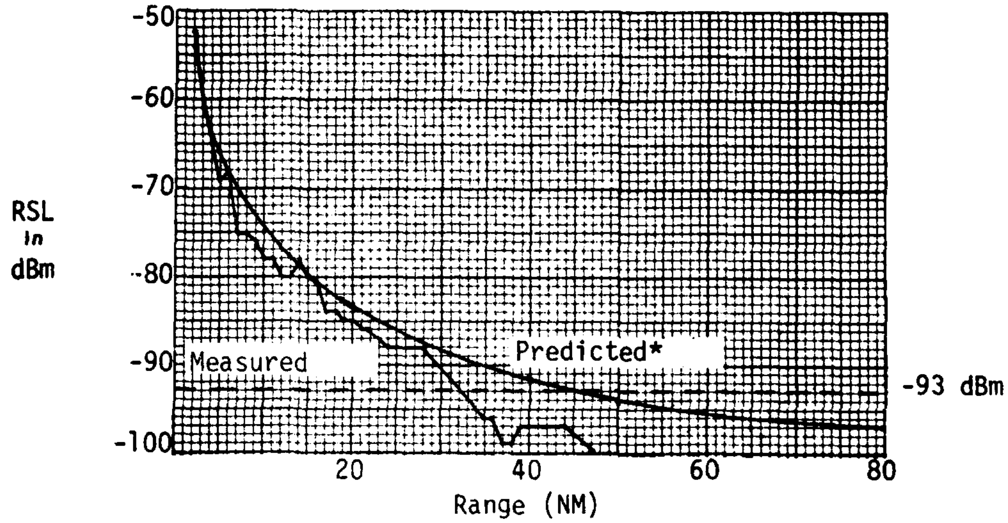
Track # 5
Radial 260
Altitude 2000 feet MSL

REMARKS *Predicted RSL based on free space loss.
Dotted line indicates aircraft receiver squelch threshold.

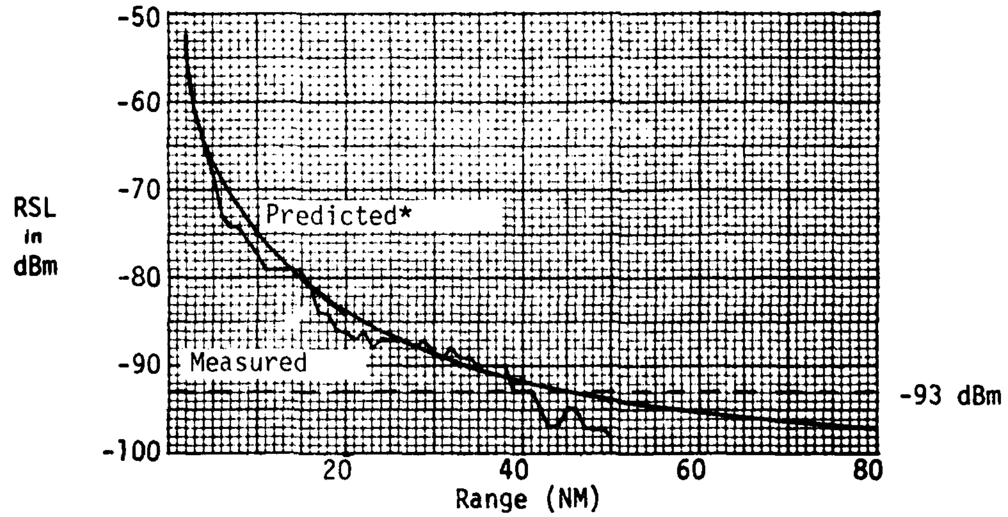
TITLE:

CORRELATION OF PREDICTED AND MEASURED RSL

LOCATION	DATE
Keesler AFB	March 1980



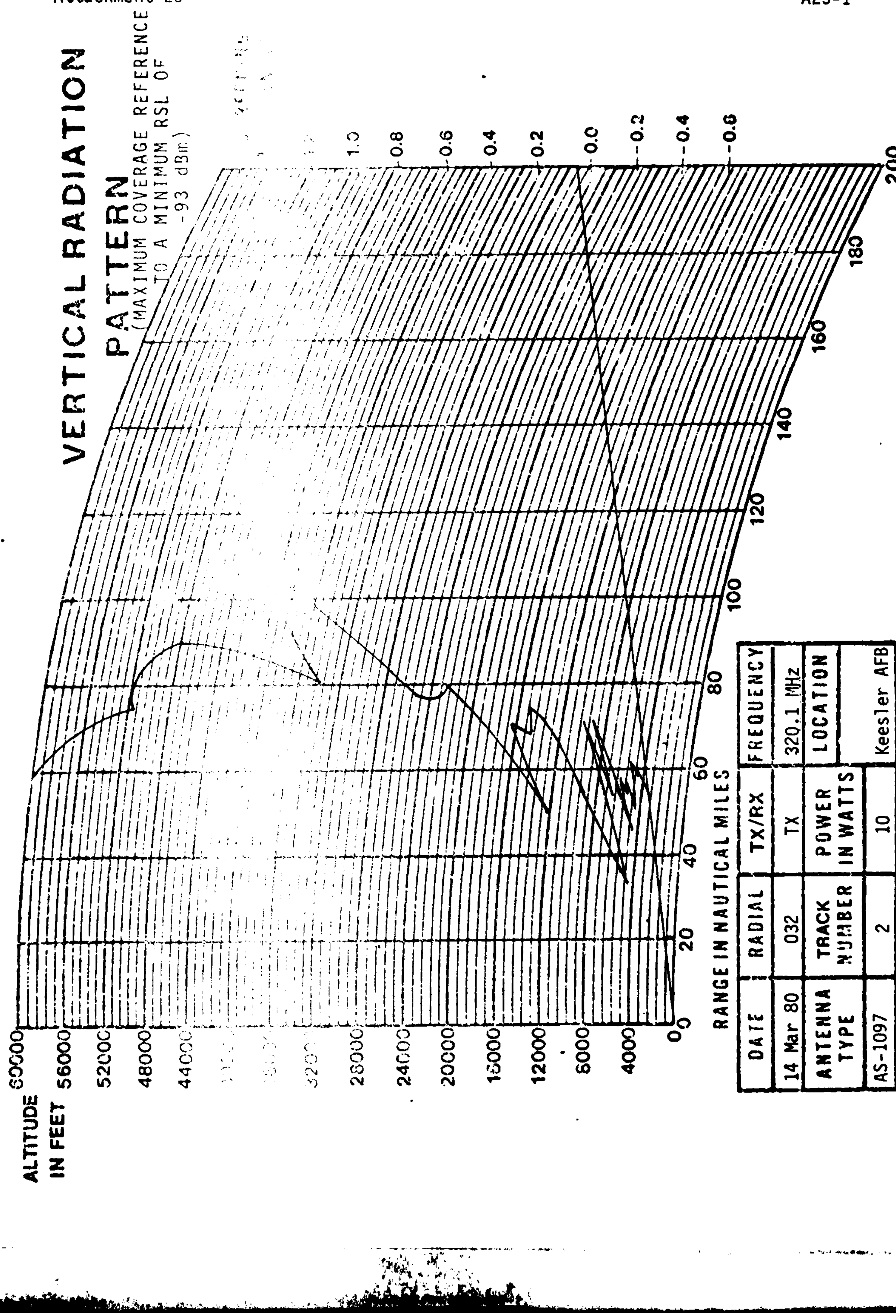
Track # 7
Radial 080
Altitude 2000 feet MSL



Track # 9
Radial 190
Altitude 2000 feet MSL

REMARKS

*Predicted RSL based on free space loss.
Dotted line indicates aircraft receiver squelch threshold.

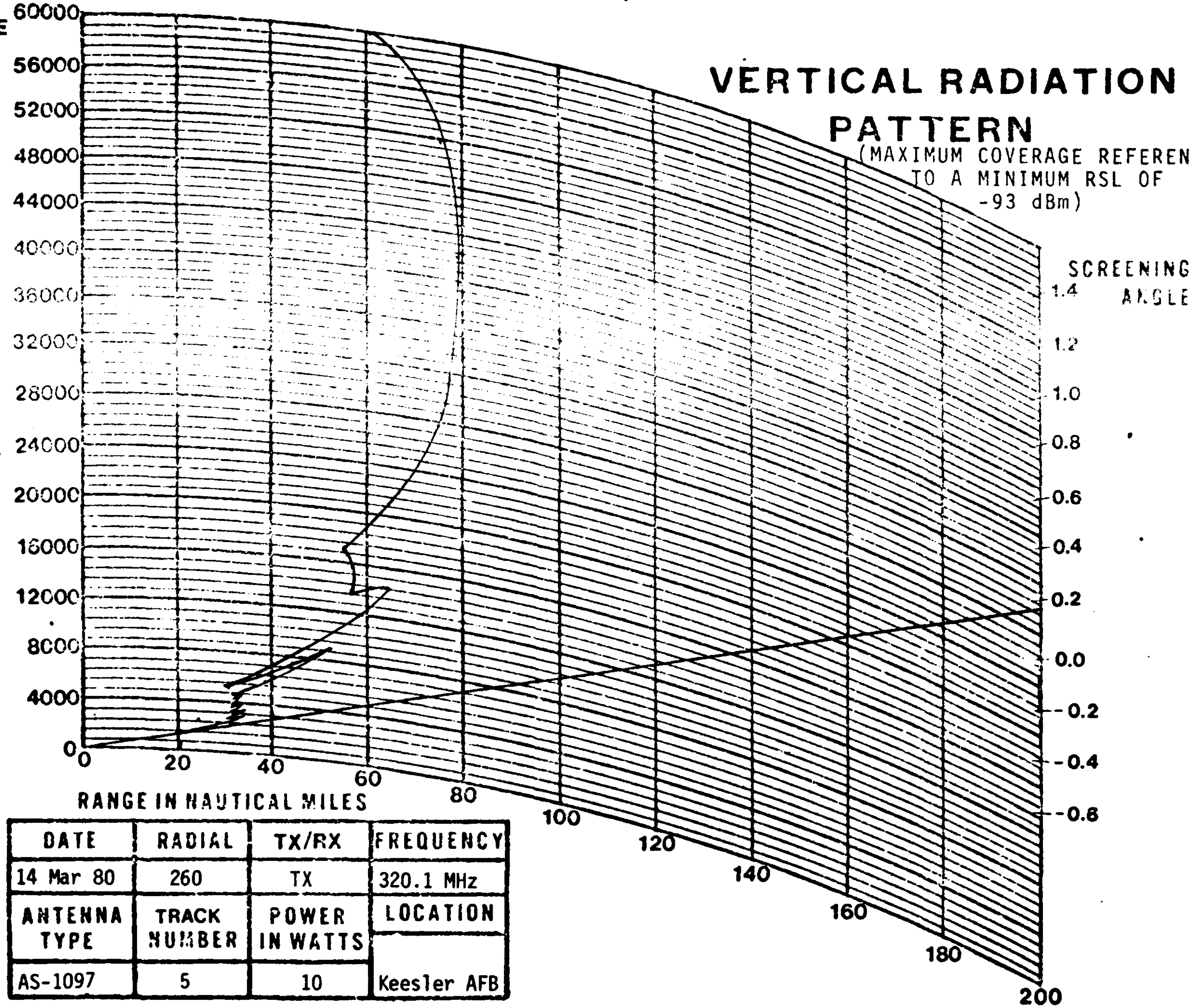


DATE	RADIAL	TX/RX	FREQUENCY
14 Mar 80	032	TX	320.1 MHz
ANTENNA TYPE	TRACK NUMBER	POWER IN WATTS	LOCATION
AS-1097	2	10	Keesler AFB

AFCS FORM MAY 78 353

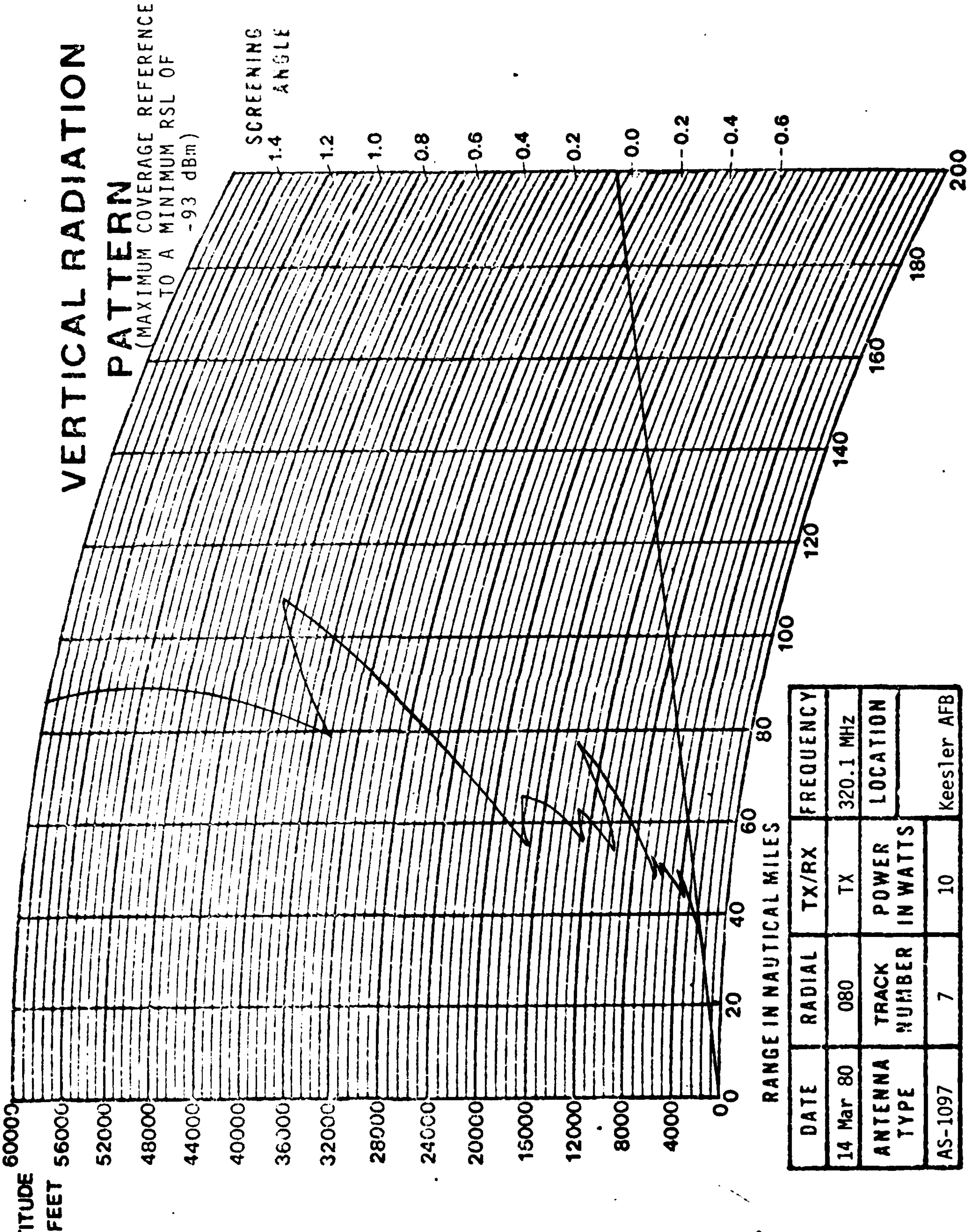
VERTICAL RADIATION PATTERN

(MAXIMUM COVERAGE REFERENCE TO A MINIMUM RSL OF -93 dBm)

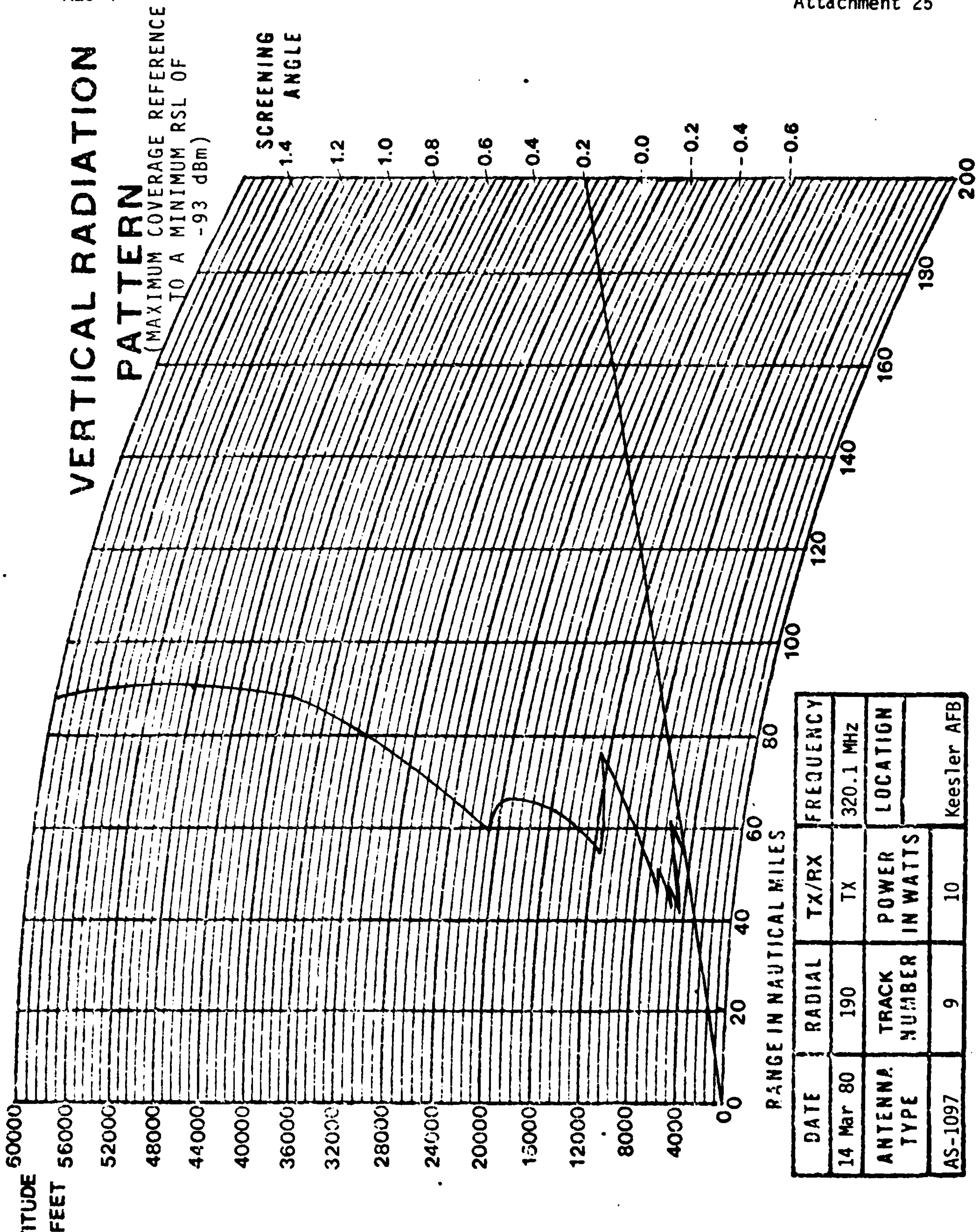


DATE	RADIAL	TX/RX	FREQUENCY
14 Mar 80	260	TX	320.1 MHz
ANTENNA TYPE	TRACK NUMBER	POWER IN WATTS	LOCATION
AS-1097	5	10	Keesler AFB

AFCS FORM MAY 78 353



DATE	RADIAL	TX/RX	FREQUENCY
14 Mar 80	080	TX	320.1 MHz
ANTENNA TYPE	TRACK NUMBER	POWER IN WATTS	LOCATION
AS-1097	7	10	Keesler AFB



DATE	RADIAL	TX/RX	FREQUENCY
14 Mar 80	190	TX	320.1 MHz
ANTENNA TYPE	TRACK NUMBER	POWER IN WATTS	LOCATION
AS-1097	9	10	Keesler AFB

PREPARED BY USAFETAC MAY 1976 | STATION NAME KEESLER AFB MISSISSIPPI(BILOXI) LOCATION N30 24 W088 55 | PERIOD MAY 42-DEC 74 ELEV 26 | STN/LTRS BIX WBAN NO 13820 WMO NO

AWS CLIMATIC BRIEF

MONTH	Temp (°F) Mean Daily Max	Mean Daily Min	Mean Monthly	Extreme Max	Extreme Min	Precip (in) Monthly Mean	Monthly Max	Monthly Min	Max 24 Hrs	Snowfall (in) Monthly Mean	Monthly Max	Max 24 Hrs	Mean Rel Humidity (%) LST 03	LST 12	Mean Vapor Pressure (in Hg)	Mean Dew Pt (°F)	Pressure Altitude (ft) 99.95%	Surface Winds Pvlg Drctn (16 pt)	Speed Mean (kt)	Speed Max (kt) **	Mean Cloud Cover (tenths)	Mean No. Days Precip (in) ≥ .01	≥ .5	Snowfall (in) ≥ 0.1	≥ 1.5	Thunderstorms	Fog Vsby < (mi)	Temp (°F) Max ≥ 90	Max ≥ 80	Min ≤ 32	Min ≤ 00
JAN	67	45	53	80	10	4.4	9.2	.9	6.5	#	#	#	84	67	.30	45	350	N	7	43	6	10	3	0	0	2	17	0	#	4	0
FEB	63	47	55	80	15	4.0	6.9	1.2	3.0	#	3	2@	83	63	.31	46	450	N	7	54	6	9	3	#	#	2	13	0	#	3	0
MAR	68	53	61	90	24	5.7	17.1	1.2	5.7	#	1	1	83	63	.38	51	450	SSE	8	50	6	10	4	#	0	5	15	#	1	#	0
APR	76	62	69	93	39	4.7	12.2	.0	7.0	0	0	0@	83	63	.50	59	400	S	8	61@	6	7	3	0	0	4	11	#	8	0	0
MAY	83	68	76	97	48	4.3	12.3	.3	5.7	0	0	0@	83	60	.64	66	300	S	7	59	5	7	3	0	0	5	5	2	25	0	0
JUN	89	74	81	101	57	5.6	14.2	.6	5.4	0	0	0	85	62	.76	71	250	S	6	56	5	9	3	0	0	9	4	10	30	0	0
JUL	90	76	83	101	60	6.9	25.2	1.7	6.5	0	0	0	86	65	.82	73	150	$ S	5	43	6	13	4	0	0	15	3	16	31	0	0
AUG	90	75	83	104	62	6.0	12.4	.3	3.6	0	0	0@	86	63	.82	73	200	$ S	5	60	5	12	4	0	0	13	5	16	31	0	0
SEP	86	71	79	98	45	6.9	18.7	.0	10.2	0	0	0	86	64	.74	70	250	$ NE	6	57	5	9	4	0	0	6	8	7	27	0	0
OCT	79	61	70	92	36	2.3	10.6	.0	3.0	0	0	0	83	57	.50	59	300	$ N	6	51@	4	6	1	0	0	2	10	#	17	0	0
NOV	69	51	60	85	26	3.5	11.1	#	5.0	0	0	0	82	60	.38	51	300	N	7	47	5	7	2	0	0	2	11	0	1	1	0
DEC	62	46	54	81	12	4.9	8.8	1.3	3.0	#	#	#	84	66	.31	46	350	$ N	7	46	6	10	3	#	#	2	15	0	#	3	0
ANN	76	61	69	104	10	62.2	25.2	.0	10.2	#	#	#	84	63	.55	59	350	$ S	7	61@	5	109	37	#	#	67	117	51	171	11	0
EYR	32	32	32	32	32	29	29	29	29	25	25	25	31	33	33	33	28	33	33	26	25	29	29	25	25	25	25	32	32	32	32

REMARKS

RUSSWO POR.

HOURLY OBS: MAY 42-DEC 74 WINDS FROM HURRICANE CAMILLE ON 17 AUG 69 WERE MEASURED AT 81 MPH WITH GUSTS TO 129 MPH.

DAILY OBS: MAY 42-DEC 74

NOTE * DATA NOT AVAILABLE # AMTS < UNITS SHOWN IN HEADING ** INSTANTANEOUS PEAK WINDS $ % CALM GRTR % PVLG DRCTN @ BASED ON < FULL MONTHS

CAV FREQ (%)	HRS LST	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN	EYR
CEILING LESS THAN 3000 FT AND/OR VISIBILITY LESS THAN 3 MI	00-02	36	32	34	28	15	9	6	4	11	9	22	30	20	25
	03-05	39	35	35	31	18	11	8	6	14	14	23	32	22	31
	06-08	39	35	35	31	19	13	10	9	17	15	24	36	24	33
	09-11	34	29	30	23	15	12	12	11	16	11	18	30	20	33
	12-14	29	25	24	17	13	9	11	11	15	9	15	25	17	33
	15-17	27	22	23	17	10	8	8	8	12	8	13	24	15	33
	18-20	29	22	24	20	11	8	6	6	11	7	14	27	15	33
	21-23	33	26	28	23	11	7	4	3	9	7	16	28	16	33
	ALL HRS	33	28	29	24	14	10	8	7	13	10	18	29	19	
CEILING LESS THAN 1500 FT AND/OR VISIBILITY LESS THAN 3 MI	00-02	29	26	28	21	8	2	1	1	5	7	16	23	14	25
	03-05	32	29	29	24	10	4	2	2	7	11	18	24	16	31
	06-08	31	28	29	22	10	5	4	4	11	11	18	28	17	33
	09-11	26	21	21	13	5	3	3	3	8	6	11	22	12	33
	12-14	20	15	15	9	4	2	2	2	6	3	8	16	9	33
	15-17	18	14	16	10	4	3	2	2	5	3	8	16	8	33
	18-20	21	15	18	14	6	2	2	2	4	4	9	18	10	33
	21-23	26	20	21	18	7	2	1	1	4	4	12	21	11	33
	ALL HRS	25	21	22	16	7	3	2	2	6	6	13	21	12	
CEILING LESS THAN 1000 FT AND/OR VISIBILITY LESS THAN 2 MI	00-02	25	22	23	15	3	1	1	1	3	5	12	19	11	25
	03-05	28	23	25	17	5	2	2	1	5	8	15	21	13	31
	06-08	27	23	25	15	6	2	2	2	8	8	14	23	13	33
	09-11	20	16	16	7	2	1	1	1	5	3	8	17	8	33
	12-14	15	11	11	5	1	1	1	1	3	2	5	11	6	33
	15-17	14	10	11	6	2	1	1	1	2	2	6	11	6	33
	18-20	17	11	15	9	2	#	1	1	2	2	7	14	7	33
	21-23	22	15	18	12	2	#	1	1	2	3	9	17	9	33
	ALL HRS	21	16	18	11	3	1	1	1	4	4	10	17	9	
CEILING LESS THAN 200 FT AND/OR VISIBILITY LESS THAN 1/2 MI	00-02	12	9	8	3	#	#	0	#	0	1	4	9	4	25
	03-05	14	11	10	4	1	#	#	#	1	3	6	9	5	31
	06-08	11	8	9	3	#	#	#	#	1	2	5	8	4	33
	09-11	5	4	2	1	0	#	#	0	#	#	1	3	1	33
	12-14	3	2	1	#	0	#	#	0	#	0	#	2	1	33
	15-17	3	2	2	1	#	0	#	#	#	0	1	3	1	33
	18-20	5	3	3	1	0	0	0	#	#	0	1	4	1	33
	21-23	10	5	5	1	0	0	0	#	0	#	2	7	3	33
	ALL HRS	8	6	5	2	#	#	#	#	#	1	3	6	3	

AWS FORM APR 74 62 PREVIOUS EDITION IS OBSOLETE

DATE

FILMED

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